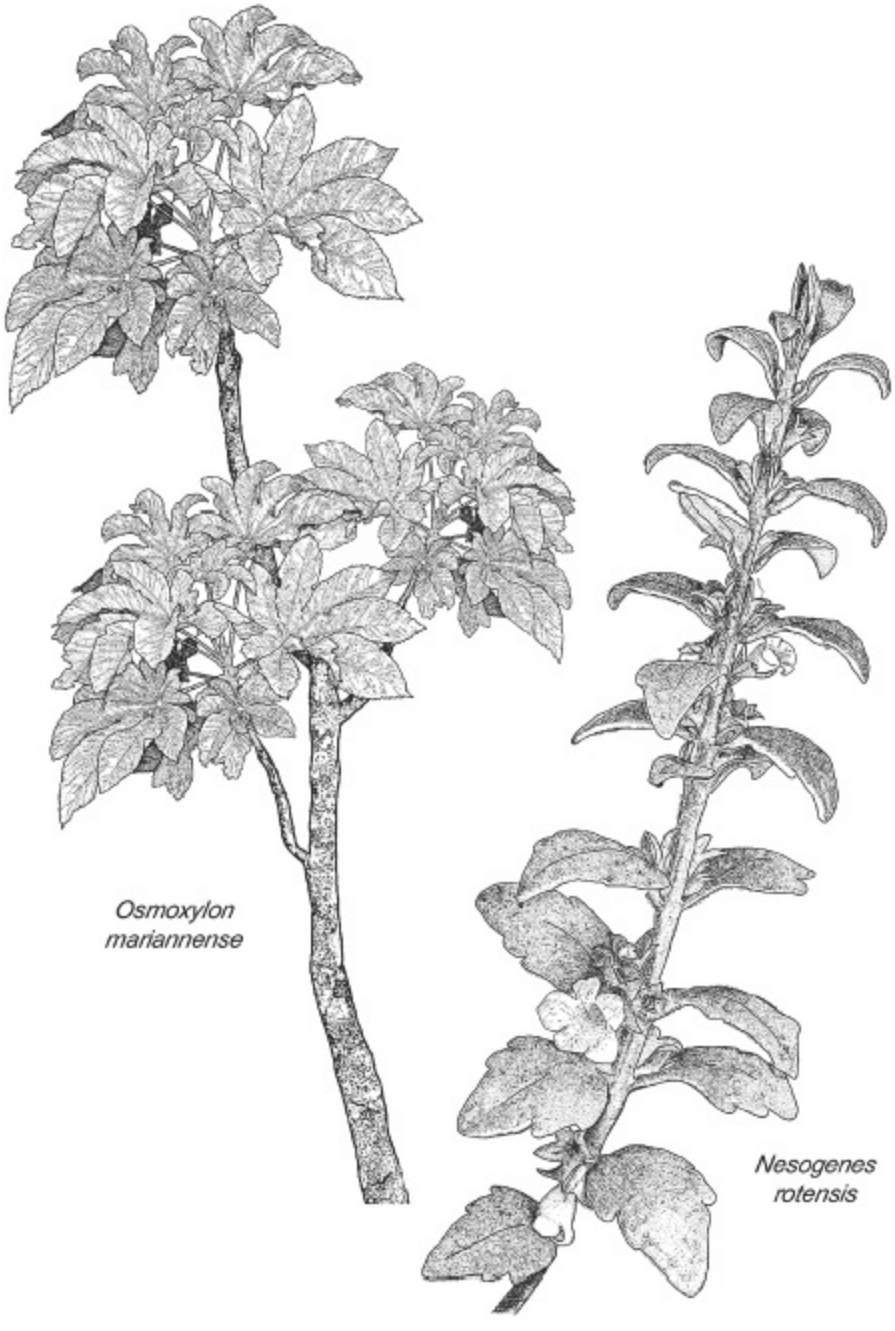
Draft Recovery Plan for Two Plants from Rota



Draft Recovery Plan

for Two Plants from Rota

(Nesogenes rotensis and *Osmoxylon mariannense)*

(FEBRUARY 2006)

Region 1

U.S. Fish and Wildlife Service

Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Regional Director, Region 1, U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and protect listed species. We, the U.S. Fish and Wildlife Service, prepare and publish recovery plans, sometimes with the assistance of recovery teams, contractors, State agencies, Tribal agencies, and other affected and interested parties. The objectives of recovery plans will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific actions and may not represent the views nor the official positions or approval of any individuals or agencies involved in recovery plan formulation, other than our own. They represent our official position *only* after they have been signed by the Regional Director or Director as *approved*. Recovery plans are reviewed by the public and submitted to peer review before we adopt them as approved final documents. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

Literature citation of this document should read as follows:

U.S. Fish and Wildlife Service. 2006. Draft Recovery Plan for Two Plants from Rota (*Nesogenes rotensis* and *Osmoxylon mariannense*). U.S. Fish and Wildlife Service, Portland, Oregon. 77+ x pp.

An electronic copy of this plan is available at:

<http://pacific.fws.gov/ecoservices/endangered/recovery/default.htm> and also at <http://endangered.fws.gov/recovery/index.html>.

ACKNOWLEDGMENTS

This recovery plan was prepared by the U.S. Fish and Wildlife Service's Pacific Islands Fish and Wildlife Office in cooperation with the Commonwealth of the Northern Mariana Islands Department of Land and Natural Resources. Its completion would not have been possible without their assistance.

Many individuals and organizations have contributed to our knowledge of *Nesogenes rotensis* and *Osmoxylon mariannense* and work cooperatively with us to recover these species. We would especially like to thank the following individuals for their support: James Manglona, Lynn Raulerson, Stan Taisican, and Laura Williams.

EXECUTIVE SUMMARY

Current Status: The plants *Nesogenes rotensis* and *Osmoxylon mariannense* (no common names) are found only on the island of Rota in the Commonwealth of the Northern Mariana Islands (CNMI). *Nesogenes rotensis* is a low-growing herbaceous plant in the Verbena family (Verbenaceae) and *Osmoxylon mariannense* is a spindly, soft-wooded tree in the ginseng family (Araliaceae). Both species were federally listed as endangered in 2004 (U.S. Fish and Wildlife Service [USFWS] 2004). *Osmoxylon mariannense* is also protected by the government of the CNMI. Currently, there are 2 known populations of *N. rotensis* of 15 to 20 plants each. The 10 known individuals of *O. mariannense* are scattered through the Sabana (the cloudswept plateau that dominates the western half of Rota).

Habitat Requirements: *Nesogenes rotensis* is found on exposed, raised limestone flats in non-forested coastal strand habitat. These flats are subject to salt spray during severe storms. *Osmoxylon mariannense* is found in limestone forests on the Sabana, a raised plateau unique in the Mariana archipelago, that are often shrouded in clouds and mist.

Limiting Factors: Human activities that alter native vegetation and habitat are believed to be the primary factors leading to the small population sizes and limited distribution of *Nesogenes rotensis* and *Osmoxylon mariannense*. These activities include agriculture, ranching, nonnative plant and animal introductions, resort and beach park development in the coastal habitat of *N. rotensis*, and road construction and maintenance in the Sabana habitat of *O. mariannense*. In the last decade, several major typhoons have made landfall on Rota, severely impacting individuals of both species. Another factor that may affect the recovery of these two species is their vulnerability to extinction from reduced reproductive vigor due to their small population sizes.

Recovery Strategy: Recovery of *Nesogenes rotensis* and *Osmoxylon mariannense* focuses on the following actions: (1) Assessing the impacts of predation by introduced species, diseases, and determining methods for their control and eradication; (2) protecting and restoring the native strand and forest habitat of *N. rotensis* and *O. mariannense*, respectively; (3) establishing new populations and augmenting existing populations of these species through controlled propagation and outplanting; and (4) building public support for conservation.

Recovery Priority Numbers: *Nesogenes rotensis* has a recovery priority number of 2 on a scale of 1 (highest) to 18 (lowest), reflecting a high degree of threat, high recovery potential, and its taxonomic status as a full species. *Osmoxylon mariannense* has a recovery priority number of 5, reflecting a high degree of threat, low recovery potential, and its taxonomic status as a full species.

Recovery Goals: Conserve and recover *Nesogenes rotensis* and *Osmoxylon mariannense* in order to remove them from the Federal List of Endangered and Threatened Wildlife and Plants (delisting). The interim goal is to control threats and increase population sizes and geographic distribution sufficient to reclassify or downlist these two endangered species to threatened status.

Recovery Objectives: Restore and maintain multiple naturally reproducing populations of *Nesogenes rotensis* and *Osmoxylon mariannense* on the island of Rota such that the protections of the Endangered Species Act are no longer necessary.

Recovery Criteria: *Nesogenes rotensis* and *Osmoxylon mariannense* may be considered for **downlisting** to threatened status when all of the following criteria are achieved and maintained for a minimum of 5 consecutive years:

1) A total of two populations of each species are naturally reproducing, stable, or increasing in numbers. Each population of *Nesogenes rotensis* must consist of

300 mature, reproducing individuals and for each population of *Osmoxylon mariannense* there must be 100 mature reproducing individuals.

2) Sufficient habitat is protected and managed to achieve criterion 1 above.

3) Management and control of nonnative species by local, regional, Commonwealth, and Federal authorities are demonstrated to be successful and sufficient to achieve criterion 1 above.

Nesogenes rotensis and *Osmoxylon mariannense* may be considered for removal (delisted) from the Federal List of Endangered and Threatened Wildlife and Plants when all of the following criteria are achieved and maintained for a minimum of 5 consecutive years:

1) A total of four populations of each species are naturally reproducing, stable, or increasing in numbers. Each population of *Nesogenes rotensis* must consist of 300 mature, reproducing individuals and for each population of *Osmoxylon mariannense* there must be 100 mature reproducing individuals.

2) Sufficient habitat is protected and managed to achieve criterion 1 above.

3) Management and control of nonnative species by local, regional, Commonwealth, and Federal authorities are demonstrated to be successful and sufficient to achieve criterion 1 above.

4) A monitoring plan shall be developed for each species and ready for implementation, for a minimum of 5 years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

Recovery Actions Needed: 1) Coordinate and monitor recovery efforts; 2) Address factors affecting viability of the wild populations; 3) Monitor the extant *Nesogenes rotensis* and *Osmoxylon mariannense* populations, establish new

populations, and augment existing populations; and 4) Provide educational and informational opportunities to build public support for conservation.

Date of Recovery: Due to the present uncertainties regarding the roles of introduced predators, habitat loss and degradation, and the susceptibility of the wild populations to random catastrophic events, we cannot realistically estimate when delisting of *Nesogenes rotensis* and *Osmoxylon mariannense* might occur. We expect that it will likely take several decades to fully recover these species, depending on the status of controlling threats to the species and the status of their populations. As we implement this plan we anticipate that we will be able to more accurately estimate when delisting might occur.

Total Estimated Cost of Recovery: Due to the great number of unknown variables affecting the management and potential recovery of these two species, the total cost to recover *Nesogenes rotensis* and *Osmoxylon mariannense* cannot be realistically determined at this time. Future recovery actions will be initiated, implemented, and modified as informed by research and monitoring of ongoing management actions (see Recovery Actions 1 through 3). We therefore present our best estimate of recovery costs for the next 15 years, a total of $6,645,000. Approximately $2,757,000, or close to 40 percent of the estimated total, will be needed during the first 5 years of recovery implementation. A detailed cost breakdown with expected annual costs for the first 5 years of recovery implementation is provided in the Implementation Schedule. We anticipate updating and revising this recovery plan on a 5-year time schedule, as needed, and recovery cost projections will be updated accordingly at that time.

The recovery actions described in this plan are also expected to benefit the endangered Rota bridled white-eye (*Zosterops rotensis*), the endangered *Serianthes nelsonii* (tronkon guafi or hayun lagu), and the threatened Mariana fruit bat or fanihi (*Pteropus mariannus mariannus*) through habitat protection and restoration in the Sabana region of Rota.

The 15-year and first 5-year costs referenced above are broken down by recovery action priority number as follows:

Priority 1 Actions – Those actions that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

a. 15 Years: $2,181,000
b. 5 Years: $1,335,000

Priority 2 Actions – Those actions that must be taken to prevent a significant decline in population or habitat quality, or some other significant negative impact short of extinction.

a. 15 Years: $4,189,000
b. 5 Years: $1,341,000

Priority 3 Actions – All other actions necessary to meet recovery objectives.

a. 15 Years: $325,000
b. 5 Years: $167,000

Totals

a. 15 Years: $6,645,000
b. 5 Years: $2,757,000

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I. Background and Overview

A. INTRODUCTION

The plants *Nesogenes rotensis* and *Osmoxylon mariannense* (no common names) are historically known only from Rota, an island located approximately 134 kilometers (80 miles) northwest of the territory of Guam. Rota is the fourth largest island in the Mariana archipelago (Figure 1) and is the southernmost island in the Commonwealth of the Northern Mariana Islands (CNMI). Rota is approximately 20 kilometers (12 miles) long and 6 kilometers (4 miles) wide with a land area of approximately 86 square kilometers (33 square miles). The Sabana region, a 12-square kilometer (5 square mile) plateau 450-meters (1,476-feet) in elevation, dominates the western half of the island (see Figure 6). Cliffs border the Sabana region on all sides but the northeast side, where the plateau slopes down to 150 meters (492 feet) elevation and the Sinapalu plateau, which dominates the eastern half of the island. The airport and village of Sinapalu are situated on the Sinapalu plateau. The village of Songsong and the commercial port for the island are situated on the Taipingot Peninsula, a narrow peninsula jutting out to the southwest on the western coast of the island. Fringing reefs surround most of the island (Resources Northwest 1997).

Rota is a municipality in the CNMI. The human population was 3,283 in 2000, a 43 percent increase from the 1990 census estimate (U.S. Census Bureau 2003). Rota's climate is tropical marine with high humidity and uniform temperatures throughout the year. Average daytime temperatures are approximately 27 degrees Celsius (80 degrees Fahrenheit) with approximately 200 centimeters (80 inches) of rain annually and about 80 percent humidity. Rainfall averages 27 centimeters (11 inches) per month during the wet season (June to December) and 10 centimeters (4 inches) per month during the dry season (January to May) (Resources Northwest 1997).

The vegetation on Rota has been described in detail by Fosberg (1960), Falanruw *et al*. (1989), and Mueller-Dombois and Fosberg (1998). The vegetation includes primary and secondary limestone forest, atoll forest, agricultural forest, coconut plantations, *Acacia confusa* (Formosa koa) forest, secondary vegetation, open fields, grassland, and urban vegetation. Approximately 60 percent of the island is forested (Falanruw *et al*. 1989), however much of this is of medium

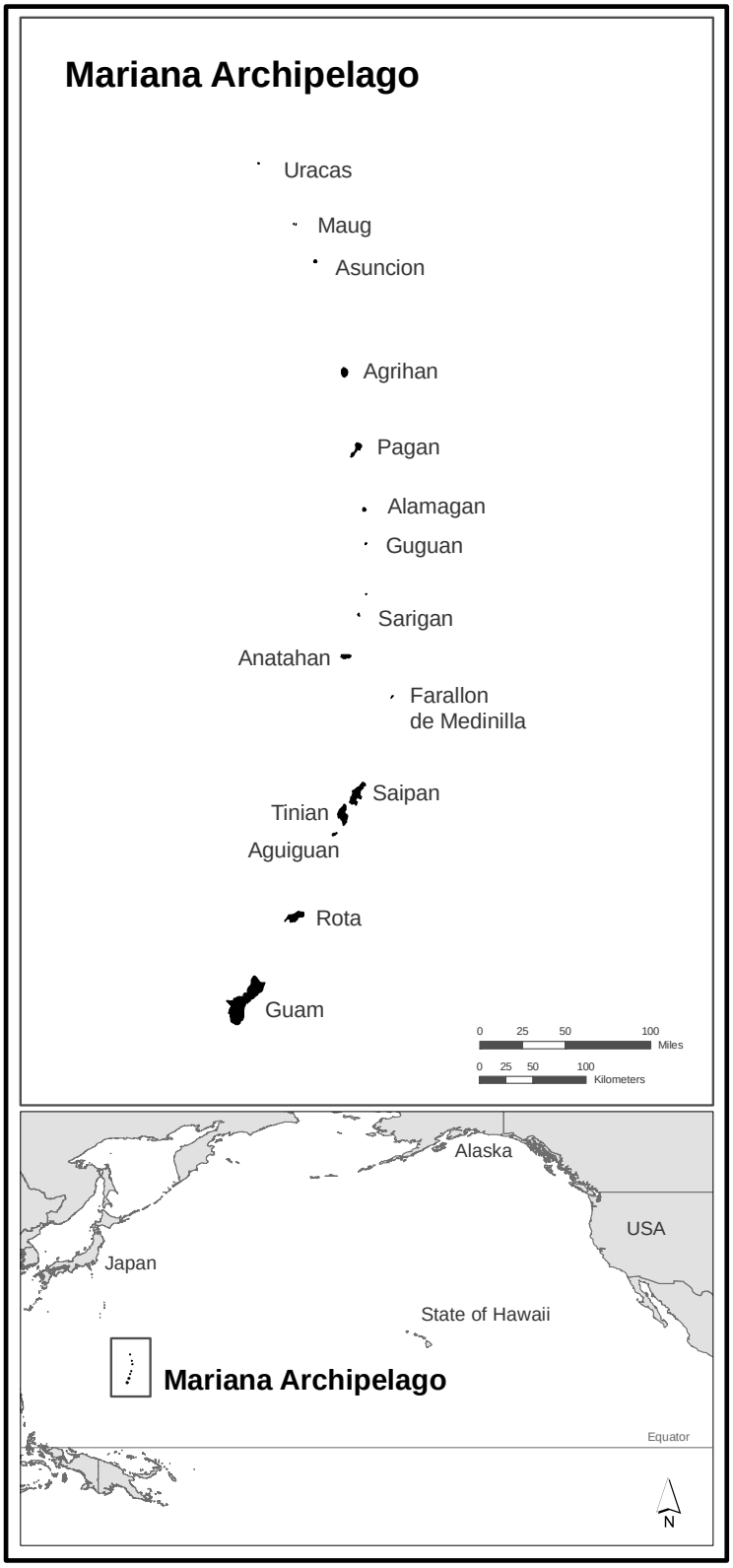

Figure 1. Map of the Mariana archipelago, showing the location of Rota.

stature and has been degraded by development activities, introduced plants and animals, logging, and the effects of warfare from World War II (*e.g*., roads, defense bunkers, artillery sites, etc.). Historically, native limestone forest varied from semi-dry forest to more or less dry-season deciduous forests on the lower terraces to wet cloud forest on the highest terraces (Fosberg 1960; Mueller-Dombois and Fosberg 1998).

The intent of this recovery plan is to guide the recovery and delisting of *Nesogenes rotensis* and *Osmoxylon mariannense*. The Background section of the plan outlines the basic biology, ecology, and status of the species and their habitats, and describes threats to the species and conservation actions that have already occurred. The Recovery section provides the actions needed to recover these species and specific criteria for measuring when recovery has occurred. The success of this plan depends upon the collaboration of many people and organizations to secure the future existence of these species.

B. STATUS OF THE SPECIES

Nesogenes rotensis and *Osmoxylon mariannense* were initially proposed for listing as endangered on June 1, 2000 (U.S. Fish and Wildlife Service [USFWS] 2000). Federal action on these plants began with the publication on February 28, 1996, of the Notice of Review of Plant and Animal Taxa (USFWS 1996). In this document, *N. rotensis* and *O. mariannense* were considered candidate species. These two species were again listed as candidate species in the September 19, 1997, Notice of Review (USFWS 1997). The final listing decision for *Nesogenes rotensis* and *Osmoxylon mariannense* was deferred due to lack of resources because the U.S. Fish and Wildlife Service's Pacific Islands Fish and Wildlife Office (where the proposed listing was initiated) staff were under court orders to designate critical habitat for 255 Hawaiian plants and 4 Hawaiian invertebrates. Pursuant to a settlement agreement approved by the U.S. District Court for the District of Hawaii on August 21, 2002, we had to make a final decision on whether to list these species and submit this decision to the *Federal Register* by April 1, 2004 (Center for Biological Diversity v. Norton, Civil No. 99–00603 (D. Haw.)). We listed *N. rotensis* and *O. mariannense* as endangered on April 8, 2004 (USFWS 2004).

Nesogenes rotensis has been assigned a recovery priority number of 2 based on its taxonomic status as a full species, a high degree of threat, and its high

potential for recovery (USFWS 1983 a,b). *Osmoxylon mariannense* has a recovery priority number of 5, reflecting its taxonomic status as a full species, high degree of threat, and a currently low potential for recovery (*e.g.*, no observed reproduction). We regularly review the status of each listed species with regard to their threats and potential for recovery and update the species' recovery priority number as appropriate.

C. SPECIES DESCRIPTION AND TAXONOMY

1. *Nesogenes rotensis*

Nesogenes rotensis is a low-growing herbaceous (non-woody) plant with small, opposite, broadly lanceolate (lance-shaped), coarsely toothed leaves. Flowers are axillary (located on a stem in the area between the stem and the petiole) and are tubular in shape, with five white petals (Figure 2). Often a flowering branch grows upright, which might aid in pollination or seed dispersal (Raulerson and Rinehart 1997). Plants typically branch near the base at about five to seven nodes, and stature may range from not quite flat-growing (subprostrate) to upward-growing (ascending), scrambling over flattened (appressed) shrubs, with whole plants up to almost 1 meter (3 feet) in diameter (Fosberg and Herbst 1983).

The type specimen of *Nesogenes rotensis* was collected on April 23, 1982, by Derral Herbst and Marjorie Falanruw from Haaniya Point (Poña Point Fishing Cliff), in the Palie area on the island of Rota, growing on exposed, dry raised limestone, at 100 meters (328 feet) elevation (Fosberg and Herbst 1983). It was growing in association with *Scaevola taccada* (nanaso), *Terminalia samoensis* (talisai ganu), *Hedyotis strigulosa* (paodedo), *Pogonatherum paniceum* (no common name), and *Bikkia tetrandra* (gausali). Fosberg and Herbst (1983) formally described the species and published the name *Nesogenes rotensis*. they placed it in the family Chloanthaceae, a largely Australian family. This placement was a change from the historic placement of the genus *Nesogenes* in the family Verbenaceae (Verbena family) and its subsequent placement in its own family, Nesogenaceae (Nesogenes family). At present, Mabberly (1990) recognizes *Nesogenes* as a genus of Verbenaceae, but states that it may simply be a matter of preference as to how to treat the genus *Nesogenes*.

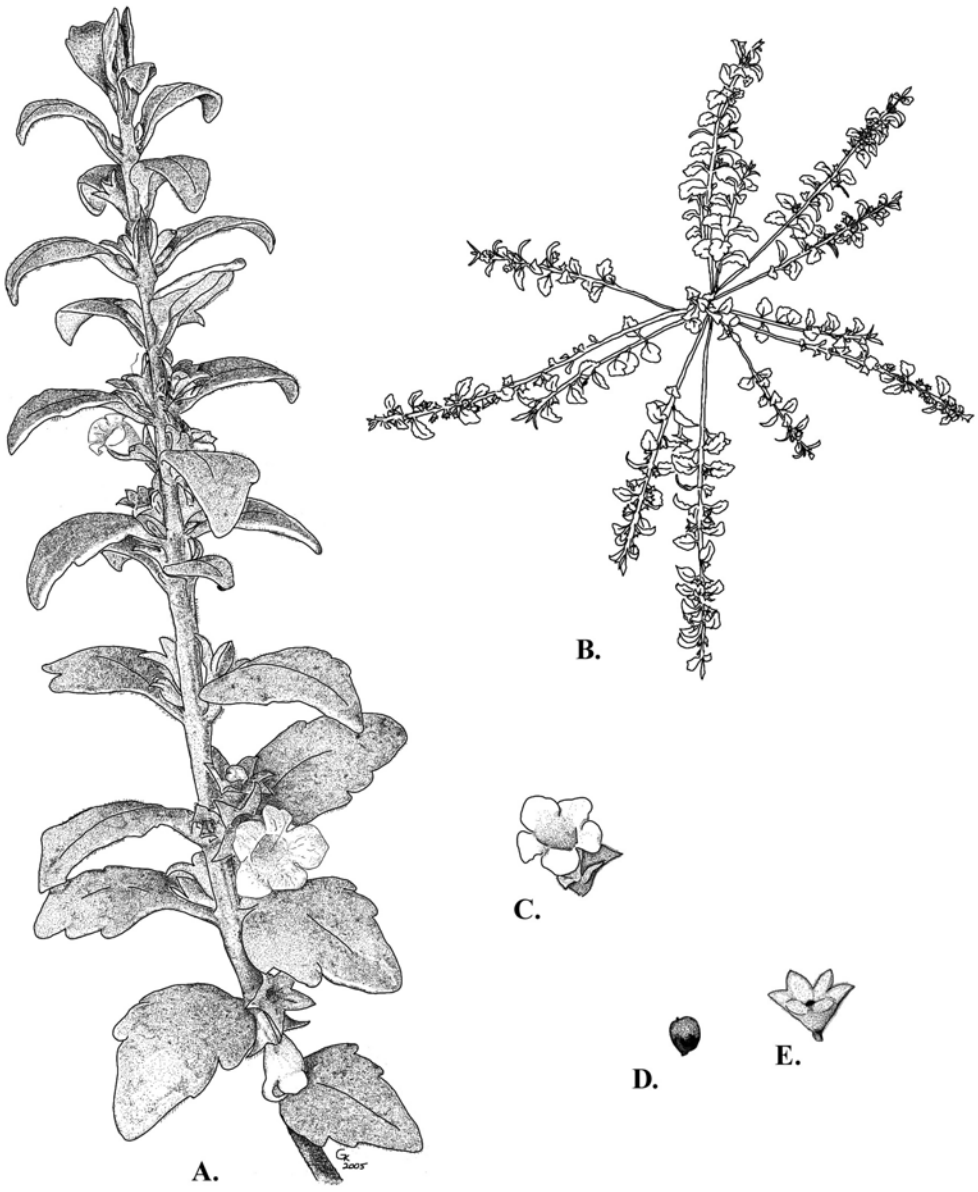

Figure 2. *Nesogenes rotensis*. **A**. Detail of flowering and fruiting stem. **B**. Habit. **C**. Flower. **D**. Seed. **E**. Fruit. Drawing © Gregory A. Koob 2005, used with permission.

2. *Osmoxylon mariannense*

Osmoxylon mariannense is a spindly, soft-wooded tree in the ginseng family (Araliaceae), which can reach 10 meters (33 feet) in height (Figure 3). It has several upward-growing (ascending), gray-barked branches that bear conspicuous leaf scars. Leaves vary in size; mature leaves are palmately lobed (hand-shaped) and about 30 centimeters (1 foot) long and 50 centimeters (1.7 feet) wide. The seven to nine lobes are coarsely toothed, and each lobe has a conspicuous, depressed mid-vein. The leaves are alternate or whorled and grow only at the branch tips. The petioles are 35 to 40 centimeters (1 to 1.5 feet) long and based in distinctive, conspicuous green multiple "sockets" (Raulerson and Rinehart 1991). The flowers are yellow and have both male and female components. They are borne in many-branched, compact terminal cymes or umbels. The fruits are round and maroon in color when ripe (Raulerson and Rinehart 1991).

Osmoxylon mariannense was first collected on Rota by French naturalist Alfred Marche, an active botanical explorer in the Mariana Islands from 1887 to 1889 (Stone 1970). It was not until 1933, however, when a study of Marche's collection was made, that Kanehira first described the species as *Boerlagiodendron mariannense* based on a collection he made in 1932 in dense primary forest at about 400 meters (1,320 feet) elevation (Kanehira 1933). In 1980, Fosberg and Sachet (1980) published the currently accepted recombination, *Osmoxylon mariannense*, which has been upheld by Raulerson and Rinehart (1991).

D. POPULATION TRENDS AND DISTRIBUTION

1. *Nesogenes rotensis*

One population of fewer than 100 plants was reported in 1982 by Derral Herbst at the Poña Point Fishing Cliff, public park land owned by the CNMI (under jurisdiction of the CNMI Department of Land and Natural Resources) (L. Mehrhoff, National Park Service, pers. comm. 1993). In 1994, Raulerson and Rinehart (1997) recorded a population of about 20 plants, occupying 200 square meters (240 square yards) of habitat, at the Poña Point Fishing Cliff. This is believed to be the same population reported by Fosberg and Herbst in their 1983

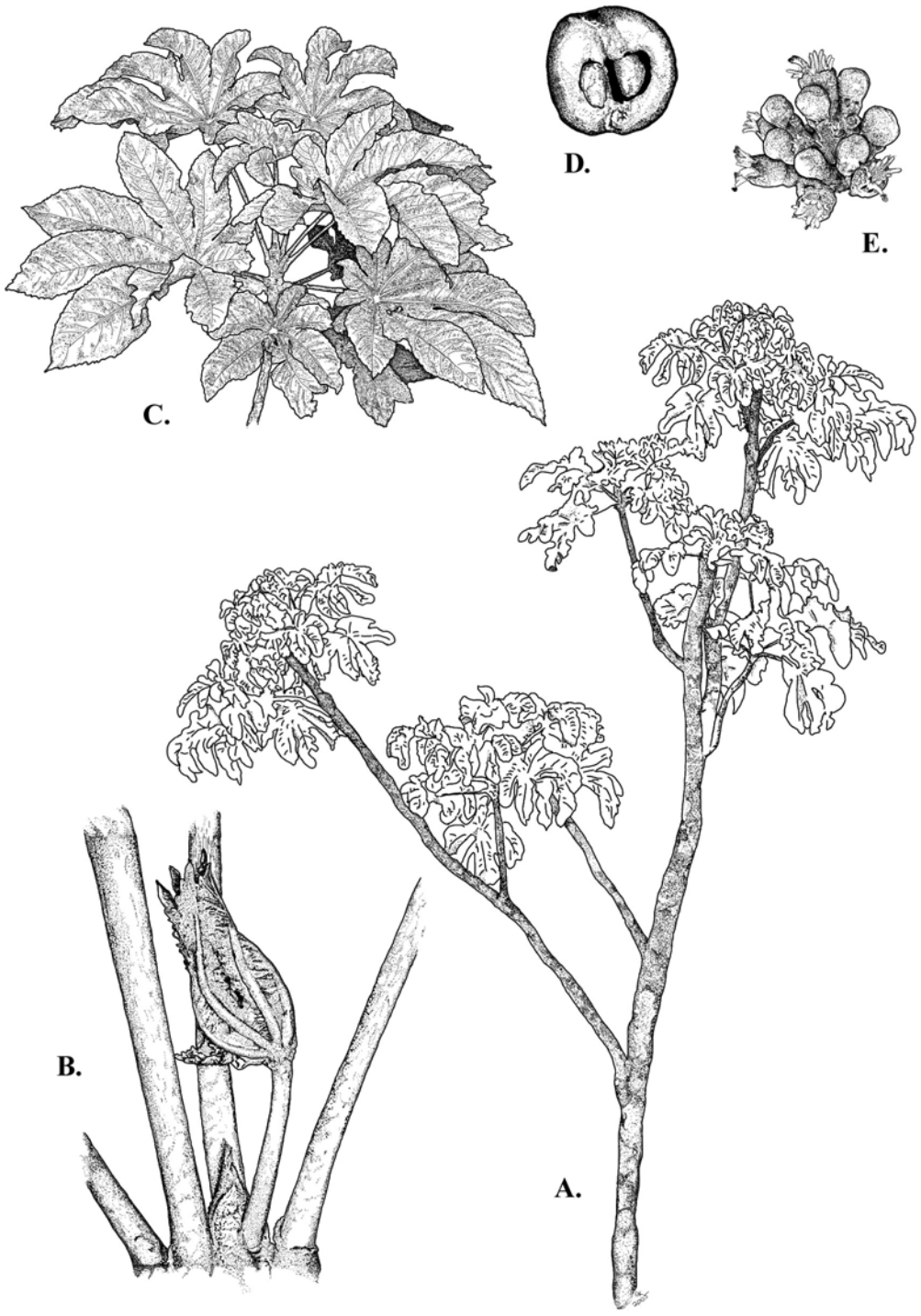

Figure 3. *Osmoxylon mariannense*. **A.** Habit. **B**. Immature leaf. **C.** Mature leaves at branch tip. **D**. Cross section of fruit, showing seeds. **E**. Flower and flower bud cluster. Drawing © Gregory A. Koob, used with permission.

publication; Herbst was uncertain of the original location when he made the herbarium sheet (Fosberg and Herbst 1983; L. Mehrhoff, pers. comm. 1993).

Biannual surveys for this species have been conducted since 2000 at Poña Point Fishing Cliff. A direct count was made on June 27, 2000. At that time there were 80 individuals within an approximate area of 800 square meters (960 square yards). In May and November 2001, direct counts made by staff from the CNMI Division of Fish and Wildlife identified 458 and 579 adult plants, respectively. No individuals of *Nesogenes rotensis* were observed in May or November of 2003 following supertyphoon Pongsona; however, 34 adults were observed in December 2003 and about 20 individuals (both seedlings and adults) were observed in March 2005 (USFWS 2004; G. Koob, *in litt.* 2005).

In March, 2005, a new population of *Nesogenes rotensis* was discovered at Puntan Fina Atkos on public land in the I Chenchon Park conservation area (Figure 4). There are 15 to 20 individuals (both seedlings and adults) in this new population, which expands the known range of the species (Gregory Koob, USFWS, *in litt*. 2005). This area had been suggested as a potential site with habitat similar to that at Poña Point in Raulerson and Rinehart (1997).

To date, this species has not been propagated and does not exist in cultivation.

2. *Osmoxylon mariannense*

Osmoxylon mariannense was first collected more than 100 years ago by Marche and was not collected again until 1932 when Kanehira made at least two collections from dense primary forest at about 400 meters (1,320 feet) elevation (Kanehira 1933). However, there are no written records of the distribution and population size of *O. mariannense* until 1980. Reports from 1980 to 1995 indicate that approximately 20 individuals from 1 scattered population were in the same vicinity as reported by Kanehira (L. Raulerson, University of Guam, pers. comm. 1998; D. Grout, USFWS, and L. Mehrhoff, pers. comms. 1997). One of the larger subpopulations had approximately nine individuals in 1994, but typhoons appeared to have damaged many of the trees, and only two were visible in 1997 (Raulerson and Rinehart 1997). *Osmoxylon mariannense* occurs as an understory species in *Pisonia umbellifera* (no common name) and *Hernandia labyrinthica*

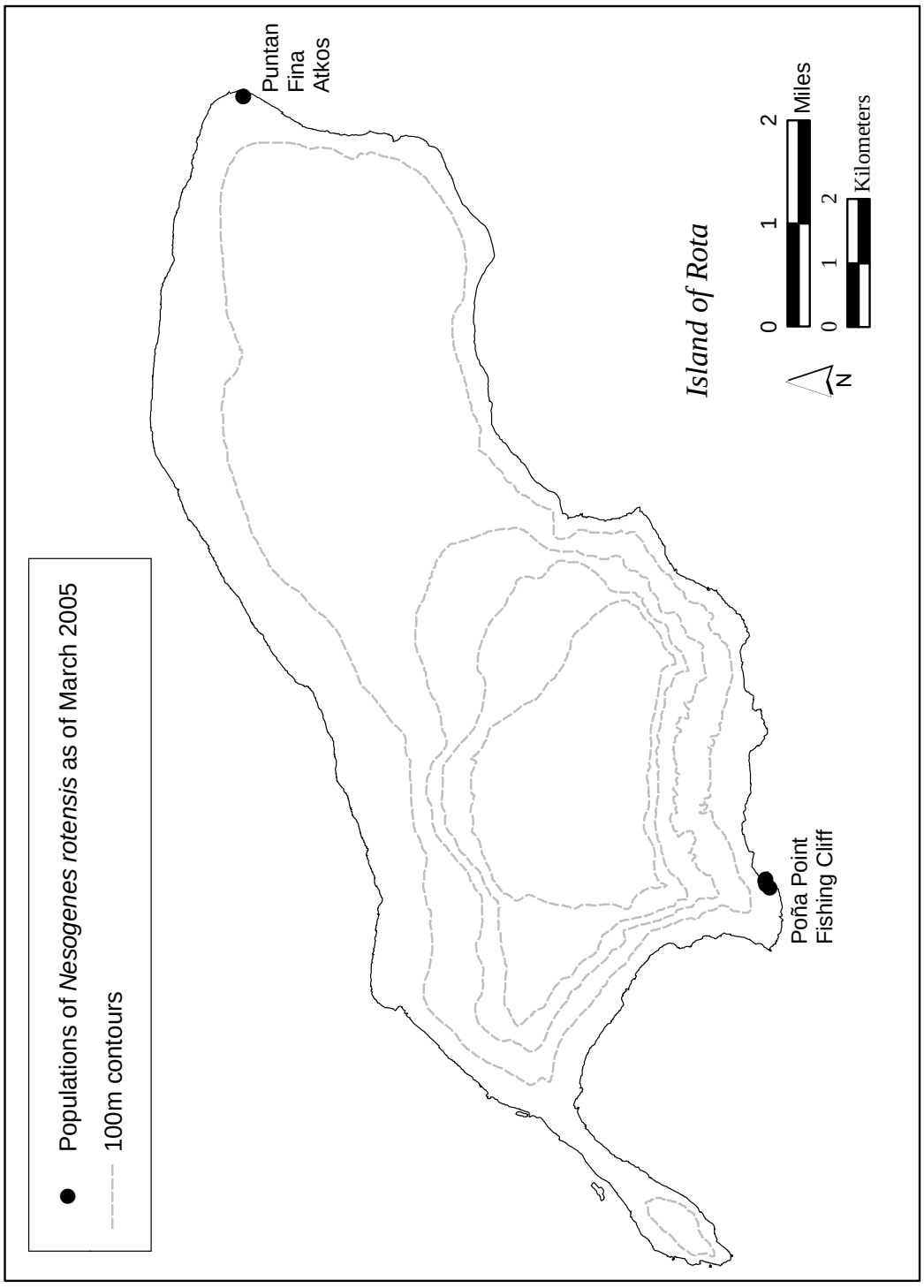

Figure 4**.** Distribution of *Nesogenes rotensis.*

(ocshal) forests, and is often hard to see until some trunks are tall enough to mingle with the trunks of the other two species (Raulerson and Rinehart 1997).

In January 1998, shortly after typhoon Paka, five occurrences, containing a total of eight trees, were observed along the Sabana road (USFWS 2000). The plants were completely defoliated and damaged by the high typhoon winds. Fifteen years before, many of the locations visited again in 1998 had had several trees each. In 1998, only single trees remained in each location, and none of these trees were reproducing naturally (G. Hughes, USFWS, pers. comm. 1998).

In 2000, a survey conducted by biologists with the CNMI Division of Fish and Wildlife identified six living and five dead individuals of *Osmoxylon mariannense* on Rota. A survey conducted in 2002 by Taisacan confirmed eight occurrences in the same vicinity, again with only one living mature tree in each location. *Osmoxylon mariannense* was found on both private (two individuals) and publicly owned (CNMI) land (six individuals). *Osmoxylon mariannense* individuals were again defoliated in 2003 during supertyphoon Pongsona; however, in 2003, Taisacan reported that some individuals were leafing out and appeared to be recovering (USFWS 2004). Currently, all eight known wild individuals of this species occur along a simple system of unimproved roads crossing the top of the Sabana (Figure 5). This distribution is possibly an artifact of limited access for surveys, as large areas of the Sabana away from the roads are difficult or dangerous to survey due to natural topography and large, often hidden holes left from abandoned mining operations.

Captive propagation of this species has been limited in its success thus far (see Conservation Efforts). An unknown number of trees currently exist in cultivation, and 2 trees that were outplanted in 2002 adjacent to wild individuals of *Osmoxylon mariannense* continue to survive, bringing the total number of currently known individuals in the wild to 10.

E. LIFE HISTORY AND ECOLOGY

1. *Nesogenes rotensis*

Little is known of the life history or ecology of *Nesogenes rotensis*. Based on information from collections and observations, *N. rotensis* flowers in March, April, May, and November (Raulerson and Rinehart 1997; G. Koob *in litt.* 2005;

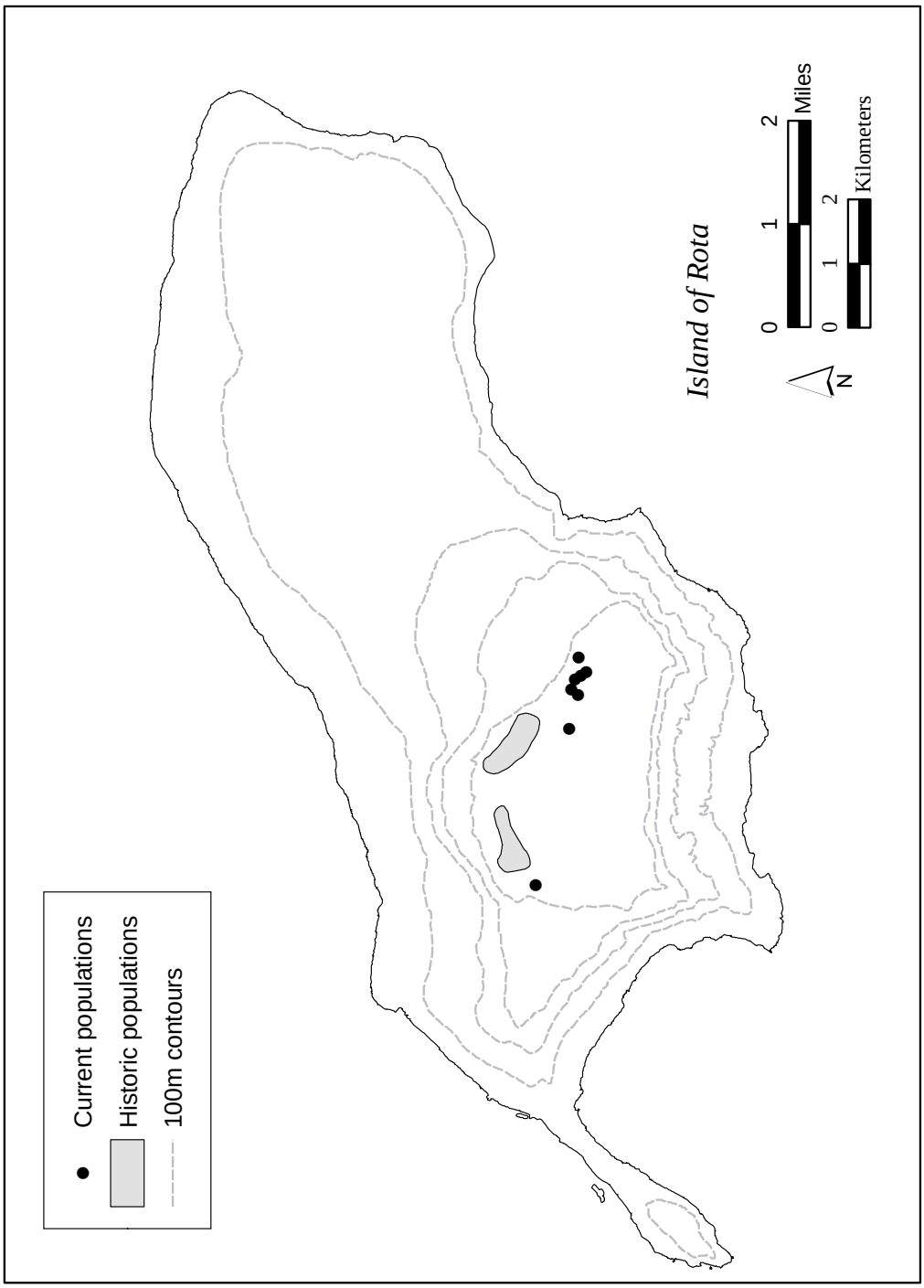

Figure 5. Distribution of *Osmoxylon mariannense.*

L. Williams, CNMI Division of Fish and Wildlife, pers. comm. 2005). It has been observed in fruit in January, March and November (Raulerson and Rinehart 1997; G. Hughes, *in litt*. 1998; G. Koob, *in litt*. 2005). All of the available information and recent observations suggest that these plants are perennials, but their above-ground parts die back annually.

2. *Osmoxylon mariannense*

Little is known of the life history or ecology of *Osmoxylon mariannense*. It occurs as an understory species in *Pisonia umbellifera* and *Hernandia labyrinthica* forests, and is often hard to see until some trunks are tall enough to mingle with the trunks of the other two species (Raulerson and Rinehart 1997). There are conflicting reports about the habitat requirements of *O. mariannense*. While some authorities consider *O. mariannense* to be an edge species (D.Grout, pers. comm. 1997; Raulerson and Rinehart 1997; L. Raulerson, pers. comm. 2005), others believe it requires shade and protection from the effects of wind by other canopy trees (E.M. Taisacan, CNMI Division of Fish and Wildlife, pers. comm. 1997; L. Williams, pers. comm. 2005). Trees have been observed flowering in February, March, and October and fruiting in January, February, March, November, and December (Raulerson and Rinehart 1997; G. Hughes, *in litt*. 1998; G. Koob, *in litt*. 2005). The fruit may provide food for birds and bats, which may also be the dispersal agents, though this is not confirmed (Raulerson and Rinehart 1991; Resources Northwest 1997; J. Manglona, Rota Forestry Services Section, pers. comm. 2005). The seeds of *O. mariannense* are difficult to germinate and this may be due to production of "false seeds" (structures that appear to be seeds but aren't) or low viability rates (J. Manglona, pers. comm. 2005; L. Raulerson, pers. comm. 2005).

F. HABITAT DESCRIPTIONS

1. *Nesogenes rotensis*

This species has been found in two locations, Poña Point on Rota's south coast and Puntan Fina Atkos on Rota's east coast. At both locations a small population exists on an exposed, raised limestone flat above a 7.6- to 30.5-meter (25- to 100-foot) seaside cliff. Although these flats are up to 30.5 meters (100 feet) above the sea, they are subject to scouring winds during severe storms. *Nesogenes rotensis* grows in association with *Scaevola taccada*, *Terminalia*

samoensis, *Hedyotis strigulosa*, *Pogonatherum paniceum*, and *Bikkia tetrandra* (Resources Northwest 1997). (Figure 6).

2. *Osmoxylon mariannense*

This tree is found in limestone forests that are often shrouded in clouds and mist on the Sabana and its escarpments. These forests occur in patches in the formerly mined Sabana and are dominated by *Hernandia labyrinthica* and *Elaeocarpus joga* (yoga) interspersed with *Pandanus* (kafu) thickets. Mixed with the *Elaeocarpus* and *Hernandia* are a few *Ficus* spp., *Artocarpus* spp., and *Hibiscus tiliaceus* (pago). Understory species include *Macaranga thompsonii* (pengua) and *Pipturus argenteus* (amahadyan). Epiphytes are abundant and include *Freycinetia reineckei* (no common name), *Asplenium nidus* (galak), *Davalia solida* (pugua-machena), and other ferns; *Coelogyne guamensis* (no common name) and other orchids; and mosses (Falunruw *et al*. 1989). (Figure 7).

G. REASONS FOR LISTING AND CURRENT THREATS

The threats to the two Mariana plants are each classified according to the five factors identified under section 4(a)(1) of the Endangered Species Act in consideration of listing, delisting, and reclassification decisions. These five factors are as follows:

A — The present or threatened destruction, modification, or curtailment of habitat or range;

B — Overutilization for commercial, recreational, scientific, or educational purposes;

C — Disease or predation;

D — Inadequacy of existing regulatory mechanisms; and

E — Other natural or man-made factors affecting the continued existence of the species.

Figure 6. Short stature coastal strand habitat for *Nesogenes rotensis.* Photo © Gregory A. Koob.

Figure 7. Limestone forest habitat for *Osmoxylon mariannense.* Photo © Gregory A. Koob.

1. *Nesogenes rotensis*

(a) Threats to Habitat (Factor A): Native vegetation, including open coastal scrubland habitat for *Nesogenes rotensis* on Rota, has undergone extreme alteration due to past and present land use practices, including ranching, deliberate and unintentional nonnative animal and plant introductions, agriculture, and military activities during World War II (Falanruw *et al*. 1989).

Currently, coastal habitat for *Nesogenes rotensis* is threatened by fragmentation and degradation associated with resort development, and potential beach park expansion and development of park facilities at the Poña Point location of *Nesogenes rotensis* (L. Williams, pers. comm. 2005). The species occurs in an area adjacent to a trail that is subject to bonfires, collecting, trampling by fishermen and tourists, and potential expansion of the park facilities, thus human impacts on its habitat is an increasing threat.

(b) Overutilization (Factor B): At this time, overutilization of *Nesogenes rotensis* is not known to be a limiting factor. Unrestricted scientific or horticultural collecting by interested individuals would significantly affect this species due to its extremely low numbers (USFWS 2004).

(c) Disease or Predation (Factor C): To date, no specific diseases have been identified for *Nesogenes rotensis*. The native parasitic vine *Cassytha filiformis* (agasi) is known to parasitize individuals of *N. rotensis*, but deleterious effects have not been documented (L. Williams, pers. comm. 2005).

(d) Inadequacy of Regulatory Mechanisms (Factor D): *Nesogenes rotensis* is not included on the "List of Protected Wildlife and Plant Species of the Commonwealth of the Northern Mariana Islands" (Table 3 of the 1999 revised Division of Fish and Wildlife regulations implementing CNMI Public Law 2–51) for Rota. The Puntan Fina Atkos population, however, is on public land in the I Chenchon Park conservation area where regulations are in place that limit human use and prohibit removal of any plant life in the area (Rota Local Law No. 9-1, 1994).

At the time of publication of the proposed rule to list *Nesogenes rotensis* as an endangered species (USFWS 2000), the CNMI government had abandoned the development of an island-wide multiple species habitat conservation plan for

Rota. The current habitat conservation plan under development for Rota addresses impacts to the endangered Mariana crow or aga (*Corvus kubaryi*) from the creation of agricultural homesteads and associated roads, and does not provide conservation measures for *N. rotensis* (A. Pangelinan, USFWS, pers. comm. 2005).

(e) Other Factors (Factor E): Rota has a long history of disturbances by tropical typhoons (Weir 1991). While native species are adapted to these events, these typhoons, in combination with human-caused disturbances and the relatively new presence of invasive species, threaten the continued existence of *Nesogenes rotensis*. Within the past decade, frequent typhoons have made landfall on Rota, severely affecting the island. Most recently, in 2003 supertyphoon Pongsona affected the Mariana Islands, particularly Guam and Rota, with winds of up to 296 kilometers (184 miles) per hour. *Nesogenes rotensis* is particularly susceptible to extirpation or extinction from a natural disaster because of its limited distribution and small numbers of individuals.

Typhoons are a common occurrence in the Mariana Islands. The nearby island of Guam, for example, has been affected by typhoons in 37 of the last 50 years (based on records compiled by the U.S. Navy, Joint Typhoon Warning Center, http://www.npmoc.navy.mil/jtwc.html). Supertyphoons (a category of severe storm, defined as having gusts exceeding 240 kilometers [150 miles] per hour) occur with regularity (about once every 5 to 10 years). There is some evidence that the frequency of severe storms (estimated gusts exceeding 160 kilometers [100 miles] per hour) is increasing in the Mariana Islands. With reference to Guam, the historical record shows increasing numbers of mild (estimated gusts in the range of 80 to 160 kilometers [50 to 100 miles] per hour) and severe storms over the last three centuries, as well as in just the last decade. While some underreporting of storms may have occurred in prior centuries, even mild storms were noticed in the colonial era because they destroyed the relatively flimsy structures used for early housing. Furthermore, these data are consistent with trends expected on the basis of increasing sea surface temperatures that have been documented in recent years (*e.g.*, Strong *et al*. 1998; U.S. Department of State 1999). The two populations of *N. rotensis* are especially vulnerable to the extreme impact of typhoons, storm surge, and high surf because their open scrubland habitats are located in coastal areas.

Nesogenes rotensis is also threatened by the nonnative *Casuarina equisetifolia* (gagu or ironwood), which is becoming established in the coastal scrubland habitat at Poña Point Fishing Cliff. This tree is known to spread by root suckers and, as observed in other areas with similar habitat, may change the coastal scrubland into a monotypic gagu forest. *Casuarina equisetifolia* forest habitat is characterized by an absence of understory vegetation due to the restriction of available sunlight and soil nutrients, and possibly the release of a chemical agent that prevents other plants from growing beneath the trees (Smith 1985; L. Williams, pers. comm. 2004).

One population (Poña Point) of *Nesogenes rotensis* is located in a public park. Human activities not only threaten the habitat for the species at this location, but the plants may also experience direct mortality and lower reproductive success due to trampling from foot traffic and bonfires set by tourists and fishermen. The small population size and extremely limited distribution of this species makes it particularly vulnerable to extinction from reduced reproductive vigor. With only 2 populations of 15 to 20 individuals, a decline of successful reproduction in *N. rotensis* could lead to the extinction of the species (USFWS 2004).

2. *Osmoxylon mariannense*

(a) Threats to Habitat (Factor A): Native vegetation, including Sabana limestone forest habitat for *Osmoxylon mariannense*, has undergone extreme alteration due to past and present land use practices, including ranching, deliberate and unintentional nonnative animal and plant introductions, agriculture, and military activities during World War II (Falanruw *et al*. 1989).

Rota was subject to extensive agricultural development (particularly cultivation of sugar cane in the lowland areas) by the Japanese prior to World War II. Currently, Rota retains less than 60 percent of its historic native forest (Falanruw *et al*. 1989). Continued loss of native forest is attributable to application of the Agricultural Homestead Act of 1990 that allows for the distribution of 1-hectare (2.5-acre) parcels of public land to eligible participants. Land use plans have proposed that approximately 25 to 45 percent of Rota be designated private agricultural homestead land or as land likely to be converted to agricultural homesteads (Resources Northwest 1997). In 2001, the Agricultural Homestead Act of 1990 was amended to allow agricultural homestead permitting

on any public lands not required for government use or reserved for other purposes by any other provision of the law. Thus, individuals awaiting permits may choose many areas of Rota's public lands for agricultural homesteads, rather than areas planned and reserved specifically for those purposes (Public Law 12–53). Therefore, the potential for agricultural development continues to threaten the remaining limestone forests on Rota, which include habitat for *Osmoxylon mariannense*. Remaining forest habitat is threatened by fragmentation and degradation associated with agricultural activities, and road maintenance and construction (D. Grout and L. Mehrhoff, pers. comms. 1997). Individuals of *Osmoxylon mariannense* on Rota were almost lost during road widening activities that occurred in the late 1990s (D. Grout and L. Mehrhoff, pers. comms. 1997).

Throughout the Mariana Islands, introduced goats (*Capra hircus*), pigs (*Sus scrofa*), cattle (*Bos taurus*), and sambar deer (*Cervus mariannus*) have severely damaged forest vegetation by browsing on plants, causing habitat degradation and erosion (Kessler 1997; Marshall *et al*. 1995) that then retards forest growth and regeneration (Lemke 1992). Of these ungulates, only nonnative deer are present on Rota where they are degrading the forests of the Sabana (L. Williams, pers. comm. 2005). These deer may also directly browse on young individuals of *Osmoxylon mariannense* (see Factor C, below).

(b) Overutilization (Factor B): At this time, overutilization of *Osmoxylon mariannense* is not known to be a limiting factor, although unrestricted scientific or horticultural collecting by interested individuals would significantly affect this species due to its extremely low numbers (USFWS 2004).

(c) Disease or Predation (Factor C): To date, no specific diseases have been identified for *Osmoxylon mariannense*. Individuals have suffered defoliation by an unknown agent (E. Taisacan, pers. comm. 1997). Defoliation (due to the poor health of the leaves), the lack of seedlings and juveniles of *O. mariannense*, and the death of several previously mapped older individual plants are suspected to be caused by unidentified invertebrate pests, mice (*Mus musculus*), rats (*Rattus* spp.), or disease (D. Grout, pers. comm. 1997).

Deer are reported to browse on seedlings of *Osmoxylon mariannense* (USFWS 2004; L. Williams, pers. comm. 2004). Cooperative efforts between the U.S. Fish and Wildlife Service and the Rota Division of Fish and Wildlife have resulted in the construction of fenced exclosures around two wild individuals.

However, the other six wild individuals of *O. mariannense* are not currently protected by fencing and are vulnerable to browsing or trampling by deer.

(d) Inadequacy of Regulatory Mechanisms (Factor D): *Osmoxylon mariannense* is included in the list of species protected by the government of the CNMI (Table 3 of the 1999 revised Division of Fish and Wildlife regulations implementing CNMI Public Law 2–51) but there are no specific prohibitions regarding collection or possession of protected plant species or requirements for the analysis of potential adverse effects associated with new projects proposed in the CNMI.

At the time of publication of the proposed rule to list *Osmoxylon mariannense* as an endangered species (USFWS 2000), the CNMI government had abandoned the development of an island-wide multiple species habitat conservation plan for Rota. The current habitat conservation plan under development for Rota addresses impacts to the endangered Mariana crow from the creation of agricultural homesteads and associated roads, but does not provide conservation measures for *O. mariannense* (A. Pangelinan, pers. comm. 2005).

(e) Other Factors (Factor E): The combination of frequent storm disturbances and resultant competition from invasive, nonnative plant species adversely affects the habitat occupied by *Osmoxylon mariannense* (L. Williams, pers. comm. 2004). While *O. mariannense* is expected to have adapted to high winds and typhoons, its distribution and numbers have been reduced significantly due to human activities, making the few remaining individuals particularly susceptible to extirpation or extinction from a natural disaster. Destruction of the Sabana forest canopy by typhoons has adversely affected *O. mariannense,* altering sub-canopy vegetation conditions over the long term by opening up and drying out older, closed forest habitat (E.M. Taisacan, pers. comm. 1998; L. Williams, pers. comm. 2004). The opening of the canopy from repeated storms also renders the forest subject to invasion by nonnative shrubs and vines that outcompete *O. mariannense.* As discussed above for *Nesogenes rotensis,* all evidence points to the increasing frequency and intensity of the threat from typhoons in this region.

Osmoxylon mariannense is threatened by competition from one or more invasive, nonnative plant species including *Momordica charantia* (bitter melon), *Mikania scandens* (climbing hempvine), and *Passiflora suberosa* (corky-stem

passionflower). In opened forest areas, these opportunistic, weedy vines cover the ground (Fosberg 1960; G. Hughes, pers. comm. 1998) and may alter the conditions necessary for seed germination and seedling growth provided in closed-canopy, high-stature forests covered with mosses and various epiphytic species.

Small population size and limited distribution make this species particularly vulnerable to extinction from reduced reproductive vigor or random environmental events. Currently, only eight naturally occurring individuals of *Osmoxylon mariannense* are known. A single adverse environmental event or a decline of successful reproduction in *O. mariannense* could lead to the extinction of this species.

H. CONSERVATION EFFORTS

1. *Nesogenes rotensis*

Attempts to propagate *Nesogenes rotensis* from seeds and cuttings have not been successful (J. Manglona, pers. comm. 2005; L. Mehrhoff, pers. comm. 2005). Surveys of the Poña Point population have been conducted twice a year every year since 2001 (L. Williams, pers. comm. 2005).

In 1994, the I Chenchon Park area was designated as a protected area through Rota Local Law No. 9-1 (Figure 9). The purpose of this protected area, according to the law, is to establish a Wildlife Conservation Area to "prohibit persons from engaging in certain activities within the ... I Chenchon Park area that may have an adverse impact on the wildlife and vegetation" (CNMI Rota Senate Local Law No. 9-1, 1994). In addition, "all persons are ... prohibited from taking or in any way harassing or disturbing ... all plant life, including any fungi, forest vegetation or grasses, with the exception of those plants that possess medicinal properties and/or those that have been used in traditional healing practices ...; and any soil, sand, or rock, within or from the area of Rota known and referred to as ... I Chenchon Park." The definition of "take" in the law includes harvesting or gathering by any method the entire plant or any part of the plant. "Harassing or disturbing" are also partly defined as "... excavation of surface land for the removal of any type of soil or plant life ... or the destruction of plant life or soil/rock/coral compositions.

2. *Osmoxylon mariannense*

Currently, staff of the Rota Forestry Service are collecting seeds from wild individuals and propagating seedlings, in cooperation with E. Taisican (CNMI Division of Fish and Wildlife, retired; J. Manglona, pers. comm. 2005). Earlier propagation efforts have had limited success. In 2001, seeds were collected from wild individuals and planted in October and March 2002. Approximately 150 individuals from the October planting had germinated by November, and as of March 2003, 11 were surviving in a nursery. They have subsequently died. The seeds planted in March 2002 produced approximately 100 seedlings. Thirty-five of these individuals initially survived but currently only two are extant and have been outplanted adjacent to wild individuals (USFWS 2004; G. Koob, *in litt*. 2005). Cooperative efforts between the U.S. Fish and Wildlife Service and the CNMI Division of Fish and Wildlife on Rota have resulted in the construction of fenced exclosures around two wild individuals. However, the other six individuals of *O. mariannense* are not protected by fencing and are currently vulnerable to browsing or trampling by deer (USFWS 2004; L. Williams, pers. comm. 2005).

In 1994, part of the Sabana region was designated as a protected area through Rota Local Law No. 9-1 (see Figure 8). The purpose of this protected area, according to the law, is to establish a Wildlife Conservation Area to, "prohibit persons from engaging in certain activities within the Sabana ...area that may have an adverse impact on the wildlife and vegetation." In addition, the law also provides for groundwater protection, and the continuation of the traditional use of medicinal plants and agricultural practices (CNMI Rota Senate Local Law No. 9-1, 1994). In 1996, a draft management plan for the Sabana Conservation Area was developed which defined the purpose of the protected area, identified zones for each use (tourism, agriculture, wildlife conservation, firing range, and communication facilities), and suggested rules for each zone. However, this management plan was never finalized or implemented and the rules, regulations, and prohibitions have not been promulgated to manage the Sabana Conservation Area as required under Rota Local Law No. 9-1 (L. Williams, pers. comm. 2005).

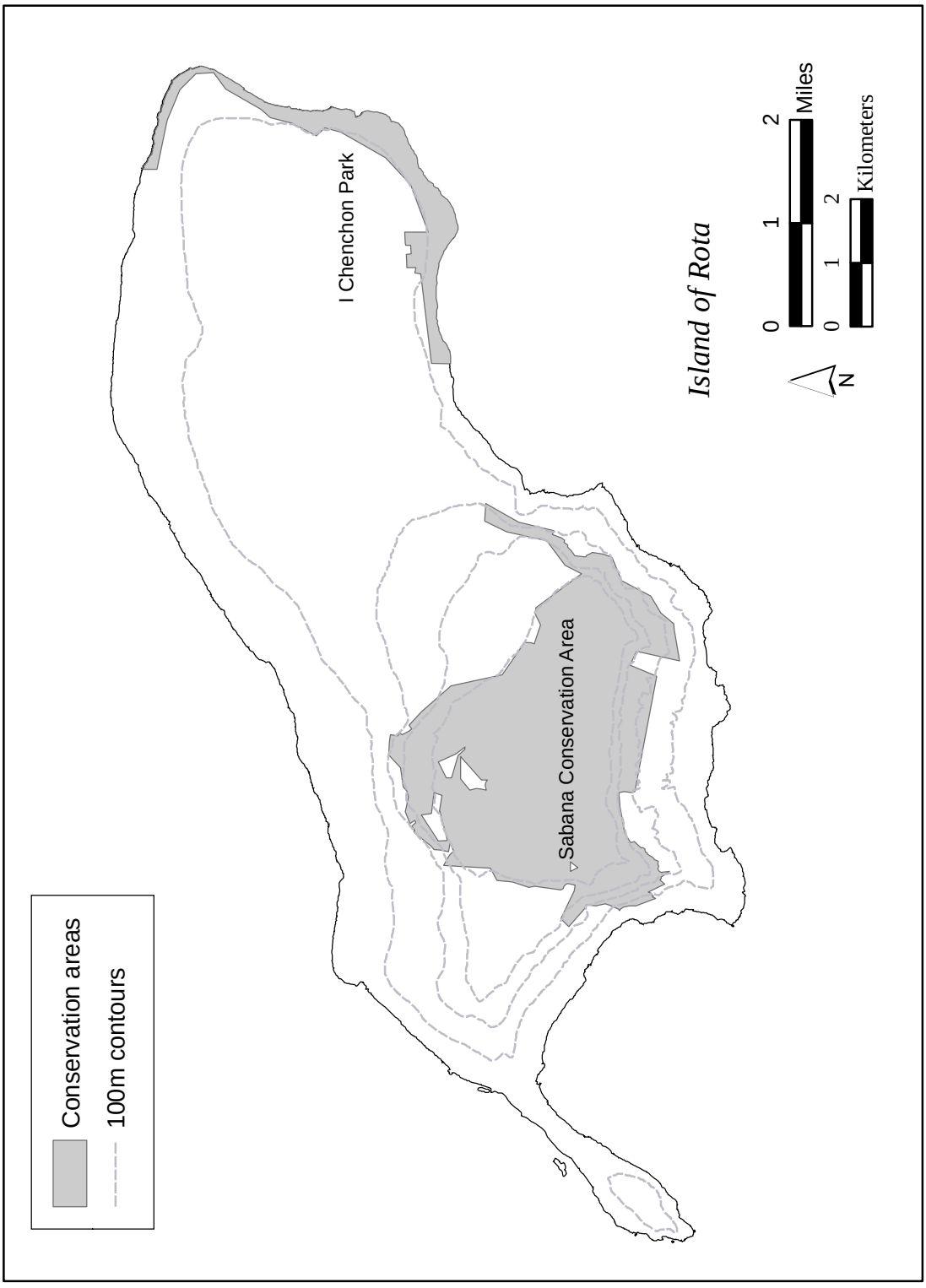

Figure 8. Conservation areas on Rota.

II. Recovery Strategy and Goals

A. RECOVERY STRATEGY

Due to their small population sizes and limited distributions, both *Osmoxylon mariannense* and *Nesogenes rotensis* are highly vulnerable to extirpation or even extinction from random catastrophic events such as typhoons and the accidental introduction of new predators. The first interim step in the recovery strategy is therefore to secure and protect the known populations and/or individuals of these endemic plant species. In order to achieve full recovery, the threats to the species must be eliminated or controlled sufficiently to be confident in the long-term persistence of the species and the ecosystem upon which they depend. Unfortunately, beyond the inherent risk posed by the small number of individuals and restricted distribution of these species, the nature and relative magnitude of any specific threats to these species is not clear and therefore cannot be addressed in an efficient manner without further research. Currently available information indicates that habitat loss and degradation and predation by introduced animals are negatively impacting *O. mariannense,* but the impact of each of these threats on *O. mariannense* is unclear and needs to be assessed. It is unclear why *N. rotensis* is found in such low numbers. Identifying and assessing the impacts of key threats to the species and determining methods for their control and eradication is a fundamental component of the long-term recovery strategy.

Recovery of these two species will clearly require the establishment or discovery of additional populations and an increase in size of the extant populations. The development of a successful captive propagation and outplanting protocol will be necessary for both species, and will serve in both population augmentation and establishment efforts. Population monitoring and collection of demographic data will reveal whether successful reproduction is occurring, and assist in evaluating progress toward population recovery goals. The specific habitat requirements of both *Osmoxylon mariannense* and *Nesogenes rotensis* must be determined, and the protection and restoration of forests in the Sabana region and non-forested coastal shrubland on the south and east coasts must be a high priority. The potential impacts of introduced deer, rats, mice, insects, diseases, and nonnative plants must be assessed and controlled as appropriate. For *O. mariannense,* the fencing of some individual trees is a stop-gap defense against deer, but we propose the effective control or elimination of nonnative deer from the forest as a more effective long-term approach to ecosystem restoration. A

similarly holistic approach is proposed for any other nonnative species that are found to pose a threat to the viability of the ecosystem, as practicable. Community support and involvement will be integral to the successful recovery of these species and their habitats, and we suggest an outreach program to involve the people of Rota in the conservation of *O. mariannense, N. rotensis,* and other native species of the island. As we learn more about the specific needs of *N. rotensis* and *O. mariannense* through the recovery process, we will reassess and refine the proposed recovery actions to ensure that these activities lead to the successful recovery, downlisting, and delisting of these two species.

B. RECOVERY GOALS

The ultimate goal of this plan is to conserve and recover *Nesogenes rotensis* and *Osmoxylon mariannense* to the point that they may be removed from the Federal List of Endangered and Threatened Wildlife and Plants (delisted). Attaining this goal requires that the threats that led to their listing have been successfully addressed, and the increased population sizes and geographic distribution have been maintained and monitored for a period of time sufficient to ensure confidence in the long-term security of the species. The interim goal is to identify and address threats and increase population sizes and geographic distribution sufficient to reclassify or downlist these two endangered species to threatened status. This recovery plan outlines actions necessary to conserve these species and the ecosystems upon which they depend. The conservation of *N. rotensis* and *O. mariannense* in the wild will depend upon the conservation of non-forested coastal shrubland and Sabana limestone forest, respectively, in appropriate quantity and quality to support multiple self-sustaining populations of these species and their habitats.

C. RECOVERY OBJECTIVES

To reach the recovery goals for *Nesogenes rotensis* and *Osmoxylon mariannense* the target recovery objectives are:

(1) Restore and maintain multiple self-sustaining populations of *Nesogenes rotensis* at Poña Point and Puntan Fina Atkos and of *Osmoxylon mariannense* in the Sabana region of Rota.

(2) Secure protection of the non-forested coastal regions on the south and north east coasts and of the Sabana forests of Rota for long-term

maintenance of the ecosystems upon which *Nesogenes rotensis* and *Osmoxylon mariannense* rely.

(3) Reduce human-induced alterations of the ecosystems in which *Nesogenes rotensis* and *Osmoxylon mariannense* occur and restore ecosystem function to maintain the ecological conditions required by these and other native species.

D. RECOVERY CRITERIA

Downlisting or delisting is warranted when a listed species no longer meets the definition of threatened or endangered under the Endangered Species Act (Box 1). We set recovery criteria to serve as objective, measurable guidelines to assist us in determining when a species has recovered to the point that the protections afforded by the Endangered Species Act are no longer necessary. However, the actual change in listing status is not solely dependent upon achieving the recovery criteria set forth in a recovery plan; it requires a formal rulemaking process based upon an analysis of the same five factors considered in the listing of a species (see page I-13). The recovery criteria presented in this recovery plan thus represent our best assessment of the conditions that would most likely result in a determination that downlisting or delisting of *Nesogenes rotensis* and *Osmoxylon mariannense* is warranted as the outcome of a formal five factor analysis in a subsequent regulatory rulemaking.

Box 1. Definitions according to section 3 of the Endangered Species Act.

Endangered Species

Any species that is in danger of extinction throughout all or a significant portion of its range.

Threatened Species

Any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

In this plan, initial criteria for downlisting and delisting are provided to guide recovery efforts. These criteria are based on reaching and maintaining estimated population goals to ensure long-term viability, protecting and preserving habitat, and removing or reducing and controlling threats to Nesogenes rotensis and Osmoxylon mariannense. However, new threats to these species may be identified as recovery efforts continue. These criteria will be revised as additional information about the species and their threats is accumulated as we begin to implement the recovery actions outlined in this plan.

Because we have only limited knowledge of the life history of each of these species with respect to specific requirements for both their short-term and long-term survival, only tentative criteria for downlisting and delisting may be credibly presented here at this time. These criteria were formulated based on recommendations by the Hawai`i and Pacific Plants Recovery Coordinating Committee (HPPRCC 1994) and discussions with various biologists and knowledgeable individuals.

Downlisting Criteria

Nesogenes rotensis and *Osmoxylon mariannense* may be considered for downlisting to threatened status when all of the following criteria are achieved and maintained for a minimum of 5 consecutive years:

1) A total of two populations of each species are naturally reproducing and stable or increasing in numbers. A stable or increasing population is defined as having a finite rate of increase (λ) greater than or equal to 1 over the requisite 5 year time period. Each population of *Nesogenes rotensis* must reach and maintain a size of at least 300 mature, reproducing individuals. Each population of *Osmoxylon mariannense* must reach and maintain a size of at least 100 mature, reproducing individuals.

2) Sufficient habitat is protected and managed to achieve criterion 1 above.

3) Management and control of nonnative species by local, Commonwealth, and Federal authorities are demonstrated to be successful and sufficient to achieve criterion 1 above.

Delisting Criteria

Nesogenes rotensis and *Osmoxylon mariannense* may be considered for removal from the Federal list of endangered and threatened species when all of the following criteria are achieved and maintained for a minimum of 5 consecutive years:

1) A total of four populations of each species are naturally reproducing and stable or increasing in numbers. A stable or increasing population is defined as having a finite rate of increase (λ) greater than or equal to 1 over the requisite 5 year time period. Each population of *Nesogenes rotensis* must consist of at least 300 mature, reproducing individuals and each population of *Osmoxylon mariannense* must at least be 100 mature reproducing individuals.

2) Sufficient habitat is protected and managed to achieve criterion 1 above.

3) Management and control of nonnative species by local, Commonwealth, and Federal authorities are demonstrated to be successful and sufficient to achieve criterion 1 above.

4) A monitoring plan shall be developed for each species and ready for implementation, for a minimum of 5 years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

III. Recovery Program

A. STEPDOWN OUTLINE OF RECOVERY ACTIONS

1. Coordinate and monitor recovery efforts

1.1. Coordinate recovery actions with other recovery and ecosystem management efforts

1.2. Update or revise recovery plan

1.3. Monitor recovery efforts and develop a post-delisting monitoring plan

2. Address factors affecting viability of the wild populations

2.1. Protect and restore *Nesogenes rotensis* and *Osmoxylon mariannense* habitat

2.1.1. Conduct research on *Nesogenes rotensis* and *Osmoxylon mariannense* habitat requirements

2.1.2. Protect, manage, and restore strand habitat of *Nesogenes rotensis* by working with the Mariana Public Lands Authority on lands they administer

2.1.3. Protect, manage, and restore limestone forest habitat of *Osmoxylon mariannense* by working with interested private landowners and the Mariana Public Lands Authority on their lands or lands they administer

2.1.3.1. Develop techniques for restoring native forest within the historic range of *Osmoxylon mariannense*

2.1.3.2. Develop and implement a reforestation plan for the Sabana

2.1.4. Evaluate the impact of introduced deer on native forest regeneration

2.1.4.1. Conduct research to determine the impact of deer on the native forest on the Sabana

2.1.4.2. Develop and implement a deer control program

2.2. Conduct surveys for *Nesogenes rotensis* and *Osmoxylon mariannense* in potentially suitably habitat

2.3. Assess and address the impact of introduced predators on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

2.3.1 Evaluate impact of invertebrates on *Nesogenes rotensis* and *Osmoxylon mariannense* populations and control, if necessary

2.3.1.1. Conduct research to determine the impact of invertebrates on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

2.3.1.2. Conduct research on methods to control invertebrates, if necessary

2.3.1.3. Develop and implement an invertebrate control and/or eradication program, if necessary

2.3.2. Evaluate the impact of introduced rats and mice on *Osmoxylon mariannense* populations, and control or eradicate, if necessary

2.3.2.1. Conduct research on *Osmoxylon mariannense* fruit predators

2.3.2.2. Develop and implement a rat and mouse control or eradication program, if necessary

2.3.3. Evaluate the impact of introduced deer on *Osmoxylon mariannense* populations and control, if necessary

2.3.3.1. Conduct research to determine the impact of deer on *Osmoxylon mariannense* populations

2.3.3.2. Conduct research on methods to control deer

2.3.3.3. Develop and implement a deer control program (see 2.1.4.2.), if necessary

2.4. Evaluate the impact of disease on *Nesogenes rotensis* and *Osmoxylon mariannense* populations and control, if necessary

2.4.1. Conduct research to determine the impact of disease on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

2.4.2. Conduct research on methods to control disease, if necessary

2.4.3. Develop and implement a disease control or eradication program, if necessary

2.5. Evaluate the impact of the parasitic vine *Cassytha filiformis* on *Nesogenes rotensis* populations and control, if necessary

2.5.1. Conduct research to determine the impact of *Cassytha filiformis* on the *Nesogenes rotensis* populations

2.5.2. Conduct research on methods to control *Cassytha filiformis*

2.5.3. Develop and implement a control program for *Cassytha filiformis*, if necessary

2.6. Evaluate the impact of nonnative plants on *Nesogenes rotensis* and *Osmoxylon mariannense* populations and control, if necessary

2.6.1 Conduct research to determine the impact of nonnative plants on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

2.6.2 Conduct research on methods to control nonnative plants

2.6.3 Develop and implement a control or eradication program for nonnative plants, if necessary

3. Monitor *Nesogenes rotensis* and *Osmoxylon mariannense* populations, establish new populations, and augment existing populations

3.1. Develop and implement long-term population monitoring programs for *Nesogenes rotensis* and *Osmoxylon mariannense*

3.2. Develop and implement a plan(s) for establishing additional populations and augmenting existing populations

3.2.1. Research collection and propagation protocols for *Nesogenes rotensis* and *Osmoxylon mariannense*

3.2.2. Determine locations for augmenting existing populations and establishing new populations of *Nesogenes rotensis* and *Osmoxylon mariannense*

3.2.3. Develop outplanting protocols for *Nesogenes rotensis* and *Osmoxylon mariannense*

4. Provide educational informational opportunities to build public support for conservation

4.1. Develop educational programs that can be incorporated into school curricula on Rota

4.1.1. Develop educator's packets for elementary to high school students

4.1.2. Develop workshops for teachers

4.2. Develop a public awareness campaign that targets citizens, community groups, and lawmakers

4.2.1. Develop and broadcast Public Service Announcements

4.2.2. Promote a poster and essay contest

4.2.3. Encourage media coverage of environmental issues

4.3. Develop and promote "hands-on" community outreach activities that protect and conserve native species and their habitat

4.3.1. Establish (or upgrade existing facilities) a series of small community-based native plant nurseries

4.3.2. Conduct a minimum of one community outplanting day per year

4.3.3. Conduct a minimum of one community native seed collection day per year

4.3.4. Promote interpretation and educational programs on the identification and importance of native plants

4.3.5. Coordinate community involvement in at least one environmental protection activity each year

B. NARRATIVE OUTLINE OF RECOVERY ACTIONS

1. Coordinate and monitor recovery efforts

Due to the complexity of issues associated with *Nesogenes rotensis* and *Osmoxylon mariannense* recovery, a recovery effort that is coordinated with the major stakeholders and interested individuals is needed. In addition, the effectiveness of this effort will depend on monitoring recovery actions and goals, and refinement or modification of management plans and programs that reflect the knowledge gained to maximize the success of the recovery program for these two plants.

1.1. Coordinate recovery actions with other recovery and ecosystem management efforts

Due to the similarities in recovery issues for listed species in the Mariana Islands, we recommend that recovery groups, Federal and Commonwealth agencies, and interested parties coordinate their conservation efforts. Holding joint meetings of agencies and other interested parties associated with recovery efforts in the Mariana Islands and maintaining open lines of communication will enable these groups and individuals to assess the progress being made in recovering listed species.

1.2. Update or revise recovery plan

The recovery plan should be reviewed, updated and revised, as necessary, as we gain further information and knowledge of the life history and ecology of *Nesogenes rotensis* and *Osmoxylon mariannense*, their habitats, and the specific nature of the threats to their persistence through research and management efforts.

1.3. Monitor recovery efforts and develop a post-delisting monitoring plan

A successful recovery program requires frequent and regular monitoring and reporting of recovery efforts. Each recovery action includes a monitoring component that will allow for review to determine its effectiveness. Prior to delisting, a post-delisting monitoring plan must be ready for implementation to ensure the ongoing recovery of the species and continuing effectiveness of monitoring actions. Monitoring under this plan must continue for a minimum of 5 years after delisting occurs.

2. Address factors affecting viability of the wild populations

Habitat loss and degradation and predation by introduced animals are believed to be impacting the *Nesogenes rotensis* and *Osmoxylon mariannense* populations. In addition, the accidental or intentional introduction of new predators, diseases, and invasive, nonnative plants also threaten the wild populations. These factors need to be assessed and addressed.

2.1. Protect and restore *Nesogenes rotensis* and *Osmoxylon mariannense* habitat

Nesogenes rotensis is restricted in distribution to native coastal shrubland while *Osmoxylon mariannense* is restricted to the Sabana native limestone forest. We surmise that the most intact native ecosystems will most likely provide suitable habitat for augmenting existing wild populations and establishing new populations of *Nesogenes rotensis* and *Osmoxylon mariannense.* Therefore, these ecosystems need to be protected from human and other disturbances and restored as necessary.

2.1.1. Conduct research on *Nesogenes rotensis* and *Osmoxylon mariannense* habitat requirements

Research on the specific habitat requirements of *Nesogenes rotensis* and *Osmoxylon mariannense* is needed to determine the best areas for reintroduction.

2.1.2. Protect, manage, and restore strand habitat of *Nesogenes rotensis* by working with the Mariana Public Land Authority on lands they administer

Currently, *Nesogenes rotensis* is found in coastal shrubland on public lands. In order to promote the recovery of this species, efforts should be undertaken to protect and manage habitat on these public lands.

2.1.3. Protect, manage, and restore limestone forest habitat of *Osmoxylon mariannense* by working with interested private landowners and the Mariana Public Lands Authority on their lands or lands they administer

Osmoxylon mariannense habitat is found on and adjacent to some private lands on the Sabana. Assistance should be provided to interested landowners to protect, restore, and manage this habitat through programs such as the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife and U.S. Department of Agriculture Natural Resources Conservation Service's Wildlife Habitat Improvement Program for private lands. Assistance to protect, restore, and manage public lands may come from programs administered by the Office of Insular Affairs, the U.S. Fish and Wildlife Service, or the CNMI Division of Fish and Wildlife.

2.1.3.1. Develop techniques for restoring native forest within the historical range of *Osmoxylon mariannense*

Techniques for restoring unforested and degraded areas need to be developed and evaluated to determine the most effective measures for restoring mature forest. These techniques might include determining how to propagate suitable native plant species, determining how to increase the regeneration of canopy and understory species in degraded areas, and determining which native plant species are best for restoring cleared areas.

2.1.3.2. Develop and implement a reforestation plan for the Sabana

Once effective techniques have been determined for restoration of native forest, an implementation plan should be developed for the Sabana. This plan should include the locations of proposed reforestation actions, an implementation schedule, monitoring protocols and schedule, and estimated costs to implement the plan. The plan could be used to obtain funding for implementing specific tasks.

2.1.4. Evaluate impact of introduced deer on regeneration of native forest on the Sabana

Introduced deer may be negatively impacting the natural regeneration of native forest in the Sabana region. Deer exclosure plots should be established within degraded forest and open fields on the Sabana and monitored to determine the impacts of deer exclusion on forest regeneration.

2.1.4.1. Conduct research to determine the impact of deer on the native forest on the Sabana

Research on effective deer control methods is needed if deer are found to significantly impact the forests of the Sabana. It is not known if a reduced number of deer would be acceptable or if complete eradication of deer is needed.

2.1.4.2. Develop and implement a deer control program

A deer control or eradication plan should be developed and implemented if it is determined that their control would be beneficial to the health of the forests on the Sabana.

2.2. Conduct surveys for *Nesogenes rotensis* and *Osmoxylon mariannense* in potentially suitable habitat

The recent discovery (March 2005) of a new population of *Nesogenes rotensis* indicates that potentially suitable habitat may harbor more individuals and populations of this species than are currently known. There are several areas of the Sabana limestone forests that may provide suitable habitat for *Osmoxylon mariannense* and for which there are no known plant surveys.

2.3. Assess and address the impact of introduced predators on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

Introduced predators are likely negatively impacting *Nesogenes rotensis* and *Osmoxylon mariannense* populations. The species need to be identified and the extent of these impacts needs to be assessed and addressed, as necessary.

2.3.1. Evaluate the impact of invertebrates on *Nesogenes rotensis* and *Osmoxylon mariannense* populations and control, if necessary

It is not known if *Nesogenes rotensis* is threatened by introduced invertebrates. Slugs and various insects have been observed on individuals of *Osmoxylon mariannense* and insects are suspected in killing seedlings of this species (J. Manglona, pers. comm 2005; L. Williams, pers. comm. 2005). Research identifying the species and assessing the impact of invertebrates on *N. rotensis* and *O. mariannense* needs to be conducted, and invertebrate control techniques need to be developed, if needed.

2.3.1.1. Conduct research to determine the impact of invertebrates on the *Nesogenes rotensis* and *Osmoxylon mariannense* populations

Currently, only anecdotal evidence is available on the impact of invertebrates on *Osmoxylon mariannense* and there is no information regarding their impact on *Nesogenes rotensis*. Research to identify the species and determine the impact of invertebrates on these listed species will enable managers to determine if control of invertebrate pests is necessary for the recovery of one or both listed species.

2.3.1.2. Conduct research on methods to control invertebrates, if necessary

Research on effective control methods may be needed if invertebrates are found to be negatively impacting either *Nesogenes rotensis* or *Osmoxylon mariannense* populations.

2.3.1.3. Develop and implement an invertebrate control or eradication program, if necessary

An invertebrate control or eradication plan should be developed and implemented if adequate control techniques are available and if it is determined that invertebrate control would be beneficial to *Nesogenes rotensis* and/or *Osmoxylon mariannense* populations.

2.3.2. Evaluate the impact of introduced rats and mice on *Osmoxylon mariannense* populations, and control or eradicate, if necessary

Rat and mouse predation on *Osmoxylon mariannense* fruit appears to affect its regeneration (D. Grout, pers. comm.. 1997; E. Taisacan, pers. comm. 2005). However, the extent of this impact is unknown at this time and should be evaluated to determine if control of these rodents is necessary for the conservation of *O. mariannense*.

2.3.2.1. Conduct research on *Osmoxylon mariannense* fruit predators

Currently, it is only suspected that rats or mice are affecting fruit availability of *Osmoxylon mariannense*. Rat-damaged fruits have been observed but it is unknown to what extent rodents are affecting the reproductive capabilities of *O. mariannense*.

2.3.2.2. Develop and implement a rat and mouse control or eradication program, if necessary

A plan for control or eradication of rats and/or mice should be developed and implemented if it is determined that rodent control would be beneficial to the reproductive success of *Osmoxylon mariannense*. This plan should identify the actions to be conducted, additional information needed, and permit requirements. The plan could be used to obtain funding for implementing specific rodent control tasks.

2.3.3. Evaluate the impact of deer on *Osmoxylon mariannense* populations and control, if necessary

Introduced deer may be negatively impacting individuals of *Osmoxylon mariannense* and the extent of this impact should be evaluated.

2.3.3.1. Conduct research to determine the impact of deer on *Osmoxylon mariannense* populations

Currently deer are known to rub, and it is believed they browse on, and may trample, individuals of *Osmoxylon mariannense* (L. Williams, pers. comm. 2004; E. Taisacan pers. comm. 2005). Research on the impacts of deer on individuals of *O. marianense* will enable managers to determine if deer control is needed.

2.3.3.2. Conduct research on methods to control deer

Research on effective deer control methods is needed if deer are found to significantly impact individuals of *Osmoxylon mariannense*. It is not known if a reduced number of deer would be acceptable or if complete eradication of deer in *O. mariannense* habitat is needed.

2.3.3.3. Develop and implement a deer control program, if necessary

A deer control or eradication plan should be developed and implemented if it is determined that their control would be beneficial to individuals of *Osmoxylon mariannense.*

2.4. Evaluate the impact of disease on *Nesogenes rotensis* and *Osmoxylon mariannense* populations and control, if necessary

It is not known if diseases are affecting *Nesogenes rotensis*. It is possible disease is responsible for the defoliation and dieback that has been observed on *Osmoxylon mariannense*. Research assessing the impact of disease on *N. rotensis* and *O. mariannense* needs to be conducted, and pathogen control techniques need to be researched, developed, and implemented, if necessary.

2.4.1. Conduct research to determine the impact of disease on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

Currently, it is only suspected that disease affects *Osmoxylon mariannense* and there is no information regarding the impact of diseases on *Nesogenes rotensis*. Research on the impact of disease

on these species will enable managers to determine if disease control is necessary for the recovery of one or both listed plants.

2.4.2. Conduct research on methods to control disease, if necessary

Research on effective disease control methods will be needed if disease(s) is found to be damaging to individuals of *Nesogenes rotensis* or *Osmoxylon mariannense*.

2.4.3. Develop and implement a disease control or eradication program, if necessary

If it is determined that disease control will be beneficial to the recovery of either *Nesogenes rotensis* or *Osmoxylon mariannense* and effective control techniques are available, a disease control or eradication plan should be developed and implemented.

2.5. Evaluate the impact of the parasitic vine *Cassytha filiformis* on *Nesogenes rotensis* populations and control, if necessary

Cassytha filiformis is a native parasitic vine known to grow on individuals of *Nesogenes rotensis* and its effect on populations of this listed species needs to be evaluated.

2.5.1. Conduct research to determine the impact of *Cassytha filiformis* on *Nesogenes rotensis* populations

Currently *Cassytha filiformis* is known to parasitize some individuals of *Nesogenes rotensis*. Research on the impact of this parasite on *N. rotensis* will enable managers to determine if control of *C. filiformis* is necessary for the recovery of *N. rotensis*.

2.5.2. Conduct research on methods to control *Cassytha filiformis*

Research on effective control methods is needed if *Cassytha filiformis* is found to significantly impact individuals of *Nesogenes rotensis*.

2.5.3. Develop and implement a control program for *Cassytha filiformis*, if necessary

A control or eradication plan should be developed and implemented if effective control techniques are available and if control or removal of this parasitic vine would be beneficial to individuals of *Nesogenes rotensis*.

2.6. Evaluate the impact of nonnative plants on *Nesogenes rotensis* and *Osmoxylon mariannense* populations and control, if necessary

Nonnative, invasive plant species can alter the function of ecosystems and compete with native species for light, water, and space. Research assessing the impact of nonnative plant species on *Nesogenes rotensis* and *Osmoxylon mariannense* needs to be conducted, control techniques need to be researched and developed, and implemented if necessary.

2.6.1. Conduct research to determine the impact of nonnative plants on *Nesogenes rotensis* and *Osmoxylon mariannense* populations

Currently *Casuarina equisitifolia* is suspected of negatively impacting the *Nesogenes rotensis* population at Poña Point. Other species of *Casuarina* are known to spread extensively by root suckers, and shade out and chemically hinder understory vegetation. Nonnative plants have invaded the Sabana forest and are changing the native limestone forest habitat of *Osmoxylon mariannense*. Research on the impacts of nonnative plant species on *N. rotensis* and *O. mariannense* will enable managers to determine if their control is necessary for the recovery of the listed plant species.

2.6.2. Conduct research on methods to control nonnative plants

Research on effective control methods may be needed if nonnative plants are found to significantly impact recovery of *Nesogenes rotensis* or *Osmoxylon mariannense*.

2.6.3. Develop and implement a control or eradication program for nonnative plants, if necessary

A control or eradication plan for nonnative plants should be developed and implemented if effective control techniques are available and it is determined that nonnative plant control would be beneficial to recover *Nesogenes rotensis* or *Osmoxylon mariannense* populations.

3. Monitor *Nesogenes rotensis* and *Osmoxylon mariannense* populations, establish new populations, and augment existing populations

Both *Nesogenes rotensis* and *Osmoxylon mariannense* exist in very low numbers. Monitoring various parameters (such as seedling establishment, population structure, etc.) is necessary to determine the effectiveness of recovery actions, evaluate recovery of the species, and indicate when timely action should be taken to prevent complete extinction or loss of individuals in the wild.

3.1. Develop and implement long-term population monitoring programs for *Nesogenes rotensis* and *Osmoxylon mariannense*

Long-term population monitoring programs for *Nesogenes rotensis* and *Osmoxylon mariannense* will enable managers implementing recovery actions for these species to assess the current status of individuals and/or populations, evaluate population trends, determine effectiveness of recovery actions, and modify recovery actions to ensure their effectiveness.

Currently the population of *Nesogenes rotensis* at Poña Point is monitored twice a year by staff of the CNMI Division of Fish and Wildlife (L. Williams, pers. comm. 2005). The population at Punta Fina Atkos was only recently discovered and a monitoring program is not yet in place for it. The 10 known individuals of *Osmoxylon mariannense*, including 8 wild and 2 outplanted trees, are occasionally monitored by Forestry Services Section staff on Rota and contactors of the CNMI Division of Fish and Wildlife (J. Manglona, pers. comm. 2005; E. Taisacan, pers. comm. 2005).

3.2. Develop and implement a plan(s) for establishing new populations and augmenting existing populations

A plan for establishing a captive propagation program should be developed and implemented. The plan should be developed cooperatively by the CNMI Division of Fish and Wildlife, the CNMI Forestry Services Section, and the U.S. Fish and Wildlife Service, and periodically reviewed and revised as new populations are established and extant wild populations are augmented. Specific tasks should be identified and a schedule for completing the tasks should be provided.

3.2.1. Research collection and propagation protocols for *Nesogenes rotensis* and *Osmoxylon mariannense*

Currently little is known regarding effective methods to collect propagules and successfully propagate either listed species. Research on the most effective collection and propagation protocols will enable managers to effectively produce the plants needed for recovery of these species.

3.2.2. Determine locations for augmenting existing populations and establishing new populations of *Nesogenes rotensis* and *Osmoxylon mariannense*

The locations for establishing new populations and augmenting existing populations should be selected once the habitat requirements of *Nesogenes rotensis* and *Osmoxylon mariannense* are determined (see Recovery Action 2.1.1).

3.2.3. Develop outplanting protocols for *Nesogenes rotensis* and *Osmoxylon mariannense*

Currently little is known regarding the most effective methods to outplant individuals of *Nesogenes rotensis* or *Osmoxylon mariannense*. Research on the most effective outplanting protocols will enable managers to effectively establish new populations and augment existing populations of each of the listed species.

4. Provide educational and informational opportunities to build public support for conservation

Public understanding and support of recovery efforts for *Nesogenes rotensis* and *Osmoxylon mariannense* and other rare species is essential to their recovery. Programs that inform teachers and educate students, lawmakers, community groups, local governmental agencies, and interested individuals should be supported, funded, and promoted.

4.1. Develop educational programs that can be incorporated into school curricula on Rota

4.1.1. Develop educator's packets for elementary through high school students

Contract a highly skilled individual with an intimate knowledge of Rota's peoples and culture and expertise in developing outreach products that comply with local curriculum standards. This individual should then help develop an educational packet focusing on elementary grades through high school that incorporates the basic skills (*i.e*., reading, writing, arithmetic, and science) while creating a positive environmental ethic towards *Nesogenes rotensis* and *Osmoxylon mariannense* (as well as other rare species of Rota) and their habitats. Initially, the educator's packets should be utilized for 2 years before a thorough evaluation of their effectiveness is conducted. The results of this evaluation should be used to revise the packets to ensure accuracy and effectiveness. The packets should be revised periodically, as needed.

4.1.2. Develop workshops for teachers

Teacher workshops should be developed and subsequently offered in order to provide orientation and guidance for the implementation of the educator's packets.

4.2. Develop a public awareness campaign that targets citizens, community groups, and lawmakers

Develop a media campaign that promotes the conservation of native species and their habitat. Ensure that residents of Rota and other islands of

the CNMI have direct involvement in the development and implementation of the campaign. Whenever applicable, the Chamorro language and culture should be incorporated into the materials.

4.2.1. Develop and broadcast Public Service Announcements

Develop and broadcast a minimum of one Public Service Announcement per year that promotes conservation of *Nesogenes rotensis* and *Osmoxylon mariannense* (and other native species) and their habitats. Public Service Announcements should utilize radio, television, and print media.

4.2.2 Promote a poster and essay contest

Promote a poster and essay contest among local school children and adults with prizes awarded from local businesses. Contest themes should focus on native species and habitat protection. The winning selections should be highlighted in a calendar and distributed on Rota.

4.2.3. Encourage media coverage of environmental issues

Encourage media coverage of environmental issues that highlight efforts by the local community to conserve and protect native species and their habitat.

4.3. Develop and promote "hands-on" community outreach activities that protect and conserve native species and their habitat

Develop a community outreach program that unites the people of Rota to actively participate in conservation activities while learning to appreciate and conserve *Nesogenes rotensis* and *Osmoxylon mariannense* (and other native species) and their habitats. Whenever applicable, the Chamorro language and culture should be incorporated into the materials.

4.3.1. Establish (or upgrade existing facilities) a series of small community-based native plant nurseries

These nurseries should be used to promote the propagation and outplanting of native plants. Locate at least one nursery each in the local elementary and high schools.

4.3.2. Conduct at least one community outplanting day per year

Outplanting sites will focus on areas of high ecological value, watersheds, and high profile public places.

4.3.3. Conduct at least one community native seed collection day per year

Collecting native seeds several times a year for the nurseries will ensure genetic integrity and diversity, and allow participants to better understand and appreciate Rota's native plants and their habitats.

4.3.4. Promote interpretation and educational programs on the identification and importance of native plants

Utilize the school nurseries to educate school children on the identification and importance of native plant species while beautifying school grounds and providing potential habitat for native animal species. The students could produce informational signs identifying each native species planted.

4.3.5. Coordinate community involvement in a minimum of one environmental protection activity a year

These activities could include beach clean-ups, streamside clean-ups, soil conservation, Earth Day, and local festivals. These activities should provide participants the opportunity to actively participate in conservation, promote *Nesogenes rotensis* and *Osmoxylon mariannense* related outreach products, raise awareness of these and other rare species on Rota, and create community pride.

IV. Implementation Schedule

The Implementation Schedule that follows outlines actions and estimated costs for the two Mariana plants recovery program as set forth in this recovery plan. It is a ***guide*** for accomplishing the objectives and actions discussed in Parts II and III of this plan. This schedule indicates action priority numbers (defined below), action numbers from the recovery action outline in Part III-A, action descriptions, anticipated duration of actions, the responsible parties, and lastly, estimated costs. In addition, the schedule indicates which of the five listing factors the action is intended to address and ameliorate (see page I-13). The initiation and completion of these actions is subject to the availability of funds, as well as other constraints affecting the parties involved.

We have the statutory responsibility for implementing this recovery plan, and only Federal agencies are mandated to take part in recovery efforts for threatened and endangered species. However, recovery of the two Mariana plants will require the involvement of the full range of Federal, Commonwealth, private, and local interests. The expertise and contributions of additional agencies and interested parties is needed to implement certain recovery actions and to accomplish education and outreach objectives. For each recovery action described in the Implementation Schedule, the column titled "Responsible Parties" lists the primary agencies having the authority or responsibility for implementing recovery actions and other groups, such as Commonwealth, private, and non-profit organizations, that also may wish to be involved in recovery implementation. The listing of a party in the implementation schedule does not require, nor imply a requirement, that the identified party has agreed to implement the action(s) or to secure funding for implementing the action(s). When more than one party is listed, the most logical lead agency (based on authorities, mandates, and capabilities), has been identified in bold type.

Definition of Action Priorities:

Priority 1 — An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2 — An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3 — All other actions necessary to meet the recovery objectives.

Definition of Action Durations:

Continual (C) — An action that will be implemented on a routine basis once begun.

To Be Determined (TBD) **—** The action duration is not known at this time or implementation of the action is dependent on the outcome of other recovery actions.

Definitions and Acronyms

Key to Acronyms used in the Implementation Schedule:

BRD	U.S. Geological Survey, Biological Resources Discipline
DFW	CNMI Division of Fish and Wildlife
DOE	CNMI Department of Education
OIA	Office of Insular Affairs
FWS-PIFWO	U.S. Fish and Wildlife Service-Pacific Islands Office
MPLA	Mariana Public Lands Authority
NRCS	Natural Resources Conservation Service
RFS	Rota Forestry Service

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
1	2.1.1.	A	Conduct research on *Nesogenes rotensis* and *Osmoxylon mariannense* habitat requirements	5	**FWS-PIFWO** BRD DFW RFS Research Institutions	90	18	18	18	18	18
1	2.1.2.	A	Protect, manage, and restore strand habitat of *Nesogenes rotensis*	C	**FWS-PIFWO** DFW MPLA NRCS	120	2	2	52	2	2
1	2.1.3.	A	Protect, manage, and restore limestone forest habitat of *Osmoxylon mariannense*	C	**FWS-PIFWO** DFW MPLA NRCS Private	540	10	10	180	10	30
1	2.2.	A, E	Conduct surveys for *Nesogenes rotensis* and *Osmoxylon mariannense* in potentially suitable habitat	2	**FWS-PIFWO** DFW	90	45	45	-	-	-

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
1	2.3.1.1.	C	Conduct research to determine the impact of invertebrates on *Nesogenes rotensis* and *Osmoxylon mariannense* populations	5	FWS-PIFWO DFW OIA **BRD** Research Institutions	100	20	20	20	20	20
1	2.3.2.1.	C	Conduct research on *Osmoxylon mariannense* fruit predators	5	FWS-PIFWO OIA **BRD** Research Institutions	100	20	20	20	20	20
1	2.3.3.1.	C	Conduct research to determine the impact of deer on *Osmoxylon mariannense* populations	5	**FWS-PIFWO** DFW Research Institutions	250	50	25	25	25	25
1	2.4.1.	C	Conduct research to determine the impact of disease on *Nesogenes rotensis* and *Osmoxylon mariannense* populations	3	FWS-PIFWO DFW **BRD** Research Institutions	75	25	25	25	-	-

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
1	2.6.1.	E	Conduct research to determine the impact of nonnative plants on *Nesogenes rotensis* and *Osmoxylon mariannense* populations	5	FWS-PIFWO DFW **BRD** Research Institutions	100	20	20	20	20	20
1	3.1.	E	Develop and implement long-term population monitoring programs for *Nesogenes rotensis* and *Osmoxylon mariannense*	C	**FWS-PIFWO** DFW RFS	98	8	8	8	8	8
1	3.2.1.	E	Research collection and propagation protocols for *Nesogenes rotensis* and *Osmoxylon mariannense*	5	**DFW** RFS	558	40	40	40	40	40
1	3.2.2.	E	Determine locations for augmenting existing populations and establishing new populations of *Nesogenes rotensis* and *Osmoxylon mariannense*	3	FWS-PIFWO **DFW** MPLA RFS	60	-	-	20	20	20
2	3.2.3.	E	Develop outplanting protocols for *Nesogenes rotensis* and *Osmoxylon mariannense*	5	FWS-PIFWO DFW **BRD**	150	-	-	-	-	-

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
2	2.1.3.1.	A	Develop techniques for restoring native forest within the historical range of *Osmoxylon mariannense*	5	**DFW** RFS BRD	125	-	-	25	25	25
2	2.1.3.2.	A	Develop and implement a reforestation plan for the Sabana	C	**FWS-PIFWO** DFW MPLA private	750	50	50	50	50	50
2	2.1.4.1.	C	Evaluate impact of introduced deer on regeneration of native forest on the Sabana	C	**DFW** RFS	104	-	-	-	8	8
2	2.1.4.2. and 2.3.3.3.	C	Develop and implement a deer control program, if necessary	TBD	FWS-PIFWO **DFW** RFS OIA NRCS	TBD	-	-	-	-	-
2	2.3.1.2.	C	Conduct research on methods to control invertebrates, if necessary	5	DFW **BRD** Research Institutions	TBD	-	-	-	-	-

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
2	2.3.1.3.	C	Develop and implement an invertebrate control or eradication program, if necessary	TBD	**DFW**	TBD	-	-	-	-	-
2	2.3.2.2.	C	Develop and implement a rat and mouse control or eradication program, if necessary	C	**FWS-PIFWO** DFW OIA RFS	TBD	-	-	-	-	-
2	2.3.3.2.	C	Conduct research on methods to control deer	3	FWS-PIFWO DFW **BRD** Research Institutions	TBD	-	-	-	-	-
2	2.4.2.	C	Conduct research on methods to control disease	TBD	**BRD** Research Institutions	TBD	-	-	-	-	-
2	2.4.3.	C	Develop and implement a disease control or eradication program, if necessary	TBD	FWS-PIFWO **DFW** RFS	TBD	-	-	-	-	-

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
2	2.5.1.	C	Conduct research to determine the impact of *Cassytha filiformis* on the *Nesogenes rotensis* populations	3	FWS-PIFWO DFW **BRD** Research Institutions	60	-	-	-	-	-
2	2.6.2.	E	Conduct research on methods to control nonnative plants	TBD	FWS-PIFWO DFW **BRD** RFS Research Institutions	TBD	-	-	-	-	-
2	2.6.3.	E	Develop and implement a control or eradication program for nonnative plants, if necessary	C	FWS-PIFWO DFW **RFS**	3,000	200	200	200	200	200
3	1.1.	All	Coordinate recovery actions with other recovery and ecosystem management efforts	C	**FWS-PIFWO** DFW MPLA Private RFS	6	0.4	0.4	0.4	0.4	0.4
3	1.2.	All	Update or revise recovery plan	C	**FWS-PIFWO**	36	-	-	-	-	12

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
3	1.3.	All	Monitor recovery efforts	C	**FWS-PIFWO** DFW	30	2	2	2	2	2
3	2.5.2.	C	Conduct research on methods to control *Cassytha filiformis*	3	FWS-PIFWO DFW **BRD**	15	-	-	-	-	5
3	2.5.3.	C	Develop and implement a control program for *Cassytha filiformis*, if necessary	TBD	FWS-PIFWO **DFW** RFS	TBD	-	-	-	-	-
3	4.1.1.	All	Develop educator's packets for elementary to high school students	3	**FWS-PIFWO** DFW DOE	26	4	2	20	-	-
3	4.1.2.	All	Develop workshops for teachers	3	**FWS-PIFWO** DFW DOE	14	2	2	10	-	-
3	4.2.1.	All	Develop and broadcast Public Service Announcements	6	**FWS-PIFWO** DFW DOE	30	5	5	5	-	5

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
3	4.2.2.	All	Promote a poster and essay contest	1	**FWS-PIFWO** DFW DOE	10	-	-	10	-	-
3	4.2.3.	All	Encourage media coverage of environmental issues	C	**FWS-PIFWO** DFW RFS	15	1	1	1	1	1
3	4.3.1.	All	Establish (or upgrade existing facilities) a series of small community-based native plant nurseries	5	**FWS-PIFWO** DFW RFS	50	10	10	10	10	10
3	4.3.2.	All	Conduct a minimum of one community outplanting day a year	C	**FWS-PIFWO** DFW RFS	30	2	2	2	2	2
3	4.3.3.	All	Conduct a minimum of one community native seed collection day a year	C	**FWS-PIFWO** DFW RFS	30	2	2	2	2	2

Implementation Schedule for the Draft Recovery Plan for Two Rota Plants (*Nesogenes rotensis* and *Osmoxylon mariannense*)

Recovery Action Priority	Action Number	Listing Factor	Action Description	Action Duration (Years)	Responsible Parties	Total Cost (15 years)	Cost estimates by fiscal year (in $1,000 units)				
							2007	2008	2009	2010	2011
3	4.3.4.	All	Promote interpretation and educational programs on the identification and importance of native plants	C	**FWS-PIFWO** DFW RFS	15	1	1	1	1	1
3	4.3.5.	All	Coordinate community involvement in a minimum of one environmental protection activity a year	C	**FWS-PIFWO** DFW RFS	30	2	2	2	2	2
			TOTAL			6,709	539.4	514.4	768.4	511.4	553.4

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VI. Appendices

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APPENDIX B. Recovery Priority System

The Recovery Priority System uses the criteria of degree of threat, recovery potential, and taxonomy (level of genetic distinctiveness). By applying these criteria, all listed species are assigned a species recovery priority number of 1 through 18. A fourth factor, conflict, is a supplementary element in determining what actions are to be implemented for recovery of a species. In addition, the fourth factor gives priority, within each category, to those species that are or may be in conflict with construction or development projects. Thus, the species retains its numerical rank and acquires the letter designation of "C," indicating conflict (1C-18C). The conflict designation elevates the priority ranking, thus the highest recovery priority ranking is 1C (i.e., a ranking of 1C is higher than a ranking of 1).

A detailed discussion of the Recovery Priority System can be found in pages 43098 through 43105 of the Federal Register volume 48, number 184 of the issue from Wednesday, September 21, 1983 (with corrected table issued on page 51985 of volume 48, number 221, issued Tuesday, November 15, 1983). This table is reproduced here on page 76.

Recovery Priority Table in *Federal Register* Vol. 48, No. 221, p. 51985

Degree of Threat	Recovery Potential	Taxonomy	Priority
High	High	Monotypic genus	1
	High	Species	2
	High	Subspecies	3
	Low	Monotypic genus	4
	Low	Species	5
	Low	Subspecies	6
Moderate	High	Monotypic genus	7
	High	Species	8
	High	Subspecies	9
	Low	Monotypic genus	10
	Low	Species	11
	Low	Subspecies	12
Low	High	Monotypic genus	13
	High	Species	14
	High	Subspecies	15
	Low	Monotypic genus	16
	Low	Species	17
	Low	Subspecies	18

APPENDIX C. Proposed recovery actions to address factors currently limiting the recovery of *Nesogenes rotensis* and *Osmoxylon mariannense* and achieve the recovery criteria.

Listing Factor	Threats	Recovery Criteria	Recovery Actions (including all sub-actions)
All	All	All	1. Coordinate and monitor recovery efforts 4. Provide educational opportunities to build public support for conservation
Factor A	Habitat alteration and loss	(2)	2.1. Protect and restore habitat 2.2. Conduct surveys
Factor B	None		
Factor C	Predators and disease	(2)	2.3. Evaluate impact of introduced predators on *Nesogenes rotensis* and *Osmoxylon mariannense* populations 2.4. Evaluate impact of disease and control 2.5. Evaluate impact of parasitic vine *Cassytha filiformis* on *Nesogenes rotensis* and control
Factor D	None		
Factor E	Nonnative invasive plants	(2)	2.6. Evaluate impact of nonnative plants and control
	Small population size and limited distribution	(3)	3. Monitor *Nesogenes rotensis* and *Osmoxylon mariannense* populations, establish new populations, and augment existing populations 4. Provide educational opportunities to build public support for conservation

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